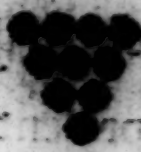
A SUPPLEMENT TO THE MISCELLANEOUS WORKS Of the Late Dr. ARBUTHNOT.



GLASGOW:

Printed for JAMES CARLILE, and Sold by the Booksellers of Great Britain and Ireland. 1768.

TO THE PUBLICK.

SINCE the Publication of the Two Volumes of this Author's Works, ſome Gentlemen have been ſo gracious to aſſiſt us with the Pieces mark'd with an Aſteriſm, which in Juſtice to the Publick we preſent them with *gratis*.

BODLEIAN LIBRARY

A SUPPLEMENT, &c.

The Freeholder's Political Catechiſm.

Anno 1733.

Queſtion, WHO *are you?*

Anſwer, I am *T. M.* a Freeholder of *Great Britain.*

Q. *What Privilege enjoy'ſt thou by being a Freeholder of* Great Britain?

A. By being a Freeholder of *Great Britain*, I am a greater Man in my Civil Capacity, than the greateſt Subject of an Arbitrary Prince; becauſe I am govern'd by Laws, to which I give my Conſent, and my Life, Liberty, and Goods, cannot be taken from me, but according to thoſe Laws: I am a Freeman.

Q. *Who gave thee this Liberty?*

A. No Man gave it me: Liberty is the Natural Right of every Human Creature; he is born to the Exerciſe of it as ſoon as he has attained to that of his Reaſon; but that my Liberty is preſerved to me, when loſt to a great part of Mankind, is owing under God to the Wiſdom and Valour of my Anceſtors, Freeholders of this Realm.

Q. *Does not every Man give up his Liberty, to the Government of the Political Society, whereof he is a Member?*

A. Mankind give up ſome part of their Natural Liberty to the Government for the Benefit of Society and mutual Defence (for in Political Society an Infant has the whole Force of the Community to protect him) but no Man can make himſelf a Slave.

Q. *Why?*

A. Becauſe no Man can give an abſolute Dominion over his Life, for that is not in his Power and belongs only to his Creator.

Q. *How comes it then that the Civil Magiſtrate has a Right to take away Lives?*

A. Becauſe by the Laws of Nature, every Man has a Power of taking away the Life of another in Self-defence, which Power is given up to the Magiſtrate, and which Power returns to every Man, when the Magiſtrate cannot defend him, as in the Caſe of being attack'd with ſudden and lawleſs Violence.

Q. *Has not the Magiſtrate a Power to compel thee to be of what Religion he thinks fit.*

A. No, Becauſe neither in the State of Nature, nor in the State of Civil Society, has any Man an abſolute Power over another Man's Mind or Conſcience; from whence it follows, that in the firſt of thoſe States, no Man could give the Magiſtrate a Power which he hath not to give: and that in the Second of thoſe States, the Exerciſe of this Power is impoſſible; Compulſion without Conviction making a Man an Hypocrite, that is a Criminal, but can never ſecure the publick Peace.

Q. *Wherein does this Liberty which thou enjoyeſt conſiſt?*

A. In Laws made by the Conſent of the People, and

and the due Execution of thoſe Laws; I am free not from the Law, but by the Law.

Q. *Wilt thou ſtand faſt in this Liberty whereunto thou art born and entitled by the Laws of thy Country?*

A. Yes verily, by God's Grace I will; and I thank his good Providence that I am born a Member of a Community governed by Laws and not by Arbitrary Power.

Q. *What do'ſt thou think incumbent upon thee to ſecure this Bleſſing to thyſelf and Poſterity?*

A. As I am a Freeholder, I think it incumbent upon me, to believe aright concerning the fundamental Articles of the Government to which I am ſubject; to write, ſpeak, and act on all Occaſions conformably to this Orthodox Faith, to oppoſe with all the Powers of my Body and Mind, ſuch as are Enemies of our good Conſtitution, together with all their ſecret and open Abettors, and to be obedient to the King the ſupreme Magiſtrate of the Society.

Q. *Rehearſe unto me the Articles of thy Political Creed?*

A. I believe that the Supreme or Legiſlative Power of this Realm reſides in the King, Lords, and Commons; That his Majeſty King *George* the Second is Sovereign or Supreme Executor of the Law, to whom upon that account all Loyalty is due. That each of the three Members of the Legiſlature are endowed with their particular Rights, and Offices; that the King by his Royal Prerogatives has the Power of determining and appointing the Time and Place of Meeting of Parliaments. That the Conſent of King, Lords, and Commons, is neceſſary to the Being of a Law, and all the three make but one Lawgiver. That as to the Freedom of Conſent in making of Laws, thoſe three Powers

are independent, and that each and all the three are bound to obſerve the Laws that are made.

Q. *Why is the Legiſlative Power Supreme?*

A. Becauſe what gives Law to all, muſt be Supreme.

Q. *What mean'ſt thou by Loyalty to the King?*

A. I have heard that *Loy* ſignifies Law; and Loyalty, Obedience, according to Law; therefore he who pays this Obedience is a loyal Subject, and he who executes the King's Command when contrary to Law is diſloyal and a Traitor.

Q. *Is it not a Maxim in the Law, that the King can do no Wrong?*

A. It is: For ſince Kings do not act immediately by themſelves, but mediately by their Officers, and inferior Magiſtrates; the Wiſdom of the Law provides ſufficiently againſt any undue Exerciſe of their Power, by charging all illegal Acts, and all kinds of Male-Adminiſtration upon their Miniſters: by the great regard which is paid to the King by this Maxim, laying him under an indiſputable Obligation, not to ſkreen his Miniſters from Publick Juſtice or Publick Enquiry.

Q. *What do'ſt thou mean by the Royal Prerogative?*

A. A Diſcretionary Power in the King to act for the Good of the People where the Laws are ſilent, never contrary to Law, and always ſubject to the Limitations of the Law.

Q. *Doeſt thou owe no other Duty to the King but Obedience according to Law?*

A. Yes. I am bound to pray for him, to honour him, to behave myſelf reſpectfully towards him, and to ſpeak reſpectfully of him, as it is written, *Thou ſhalt not ſpeak Evil of the Ruler of the People.*

Q. *Thou haſt promiſed that in order to preſerve this thy Liberty, thou wilt reſiſt to the utmoſt of thy Power the Enemies of our good Conſtitution; who are thoſe Enemies?*

A. Such

A. Such as deny the Title and Authority of the King who is acknowledg'd to be ſo by the Legiſlature: Such as by the Heretical Doctrines exalt the Royal Authority above the Laws: Such as endeavour to deſtroy the Authority and Independence of any of the three Members of the Legiſlature.

Q. *How comes it that denying the Title and Authority of the King, who is acknowledged by the two Branches of the Legiſlature, is ſubverting a fundamental Law of the Conſtitution?*

A. Becauſe if private Judgment is to be oppoſed to that of the Publick, there can be no Peace in that Society: Beſides every Man in the Society is ſuppoſed to have given his Aſſent in that Matter already, for the Act of the Majority is the Act of every Individual.

Q. *What are thoſe Heretical Doctrines which exalt the King's Authority above the Laws.*

A. Aſſerting, That there is ſomething particularly Divine in Kingly Government, as being the firſt Government of the World, and appointed by God. And that there is in Kings an Authority and Hereditary Right of Succeſſion independent of the Laws.

Q. *How canſt thou prove thoſe to be heretical and falſe Doctrines?*

A. Becauſe they are ſo far from being founded upon Scripture (as is pretended) that they are contrary to it. For firſt, It does not appear from Scripture how the firſt Political Societies were formed. Secondly, The firſt Government of God's People was not Monarchical; the Patriarchs were not Kings; the Government of the *Iſraelites* before *Saul*'s Time was Republican; the People ſent Ambaſſadors, *Joſhua* xxii. the People in full Aſſembly demands Juſtice, *Judges* xix and xx. Thirdly, God Almighty gives a diſadvantageous Character of Abſolute

ſolute Monarchy, which ſee 2 *Sam.* viii. 4. If by God's Appointment, be meant a Divine Revelation or Miſſion, no Monarch upon Earth has it: If by God's Appointment be meant the Divine Authority, enjoyning Obedience to the lawful Ordinances of Man, the Supreme Power of a Commonwealth has it as much as a King: If by God's Appointment be meant God's Providence, a Robber, Tyrant, Uſurper may be ſaid to be ſo. Fifthly, There are ſeveral Paſſages in Scripture, that favour the Original Power of the People. *Abraham* demands a Burrying-place for *Sarah* of the People. The firſt Governors ſeem to have been Captains choſen for their Valour, by the People, *whoever will give Battle* (ſay the Princes and People of *Gilead*) *to the Children of Ammon, ſhall be Head over the Inheritance of Gilead*, accordingly *Jeptha* was choſen. God Almighty demands the Conſent of the People even to his own Laws, accordingly *Moſes* propoſeth them in a full Aſſembly, and demands their Conſent as to a Covenant, *See Deut.* 5. God Almighty condeſcended to this Natural Right of the People in changing the Form of their Government (tho' contrary to his Admonition) when they demanded a King to rule over them, and commands *Samuel* to *hearken to the Voice of the People*, 2 *Sam.* viii. There are many more Proofs of this Truth to be found in Scripture, by any Man who reads with Attention.

Q. *Does not Conqueſt give a Right to abſolute Monarchy?*

A. No: For unjuſt Force can never give any juſt Dominion: And Conqueſt in a juſt War, gives the Conqueror abſolute Dominion only over the Individuals he has ſubdued.

Q. *What thinkeſt thou of Hereditary Right?*

A. No

A. No Man can have Hereditary Right by the Title of King, for there are Kingdoms Elective; ſeveral Kingdoms have different Cuſtoms and Laws in determining the Succeſſions of their Monarchs; thoſe of *Britain* and *France* are different, and both from the Cuſtoms of ſome other Monarchies; therefore there can be no Right of Succeſſion but by the Laws of the Land, and accordingly by the Act of Settlement his preſent Majeſty King *George* the Second has an Hereditary Right in himſelf and lineal Deſcendants, ſubject to the Limitations of the Law, a more authentick Deed for Hereditary Right, than can be produced by any Prince in the World.

Q. *Is not then the King above the Laws?*

A. By no means: For the Intention of Government being the Security of the Lives, Liberties, and Properties, of the Members of the Community, they never can be ſuppoſed by the Law of Nature, to give an Arbitrary Power over their Perſons and Eſtates. King, is a Title, which tranſlated into ſeveral Languages, ſignifies a Magiſtrate with as many different Degrees of Power, as there are Kingdoms in the World, and he can have no Power but what is given him by Law; yea, even the Supreme or Legiſlative Power, is bound by the Rules of Equity, to govern by Laws enacted, and publiſhed in due Form; for what is not Legal is Arbitrary.

Q. *How comes it that thoſe who endeavour to deſtroy the Authority and Independance of any of the Branches of the Legiſlature, ſubvert the Conſtitution?*

A. By the fundamental Laws of the Conſtitution, the free and impartial Conſent of each of the three

three Members is neceſſary to the Being of a Law, therefore if the Conſent of any of the Three is wilfully omitted, or obtain'd by Terror or Corruption, the Legiſlature is violated; and inſtead of three there may be really and effectually but one Branch of the Legiſlature.

Q. *Can thou illuſtrate this by any Example.*

A. The Royal Authority and that of the Houſe of Peers were both deſtroyed by the Houſe of Commons, and by a ſmall Part of That, in the late Civil War; ſo that the very Form of Government was annihilated.

Q. *Can you give me an Inſtance where the Form of Government may be kept, and yet the Conſtitution deſtroyed?*

A. Yes. The Forms of the Free Government of *Rome*, were preſerved under the Arbitrary Government of the Emperors: There was a Senate, Conſuls, and Tribunes of the People; as one might ſay King, Lords, and Commons, and yet the Government under the Emperors was always Deſpotick, and often Tyrannical; and indeed the Worſt of all Governments is Tyranny ſanctify'd by the Appearance of Law.

Q. *By what Means fell that great People into this State of Slavery?*

A. I have read the *Roman* Hiſtory, and by what I can judge, it was by Faction, Corruption, and Standing Armies.

Q. *All That might happen to* Romans; *but did ever any Parliament of this Nation give up the Liberty of the People?*

A. Yes: A Pack'd Parliament in *Richard* the Second's Time, eſtabliſhed by a Law, the King's Arbitrary Power, and with Leave to name a Commiſſion with Parliamentary Authority. Parliaments

liaments in *Henry* the Eighth's Time were Slaves to his Paſſions, and One gave the King a Legiſlative Authority. And there are many Inſtances of Parliaments making dangerous Steps towards the Deſtruction of the Liberty of the People.

Q. *Who were the Engliſh Monarchs who were moſt indulgent to the Liberties of the People?*

A. The great King *Alfred*, who declar'd, *That the Engliſh Nation was as free, as the Thoughts of Man.* The glorious Monarchs, *Edward* the Firſt, *Edward* the Third, and *Henry* the Fifth, who would not let his People ſwear to him till he had an Opportunity of ſwearing to them, at his Coronation. And the Immortal Queen *Elizabeth*, who declar'd it by Law, High Treaſon, during her Life, and a *Premunire* afterwards, to deny the Power of Parliament in limiting and binding the Deſcent or Inheritance of the Crown, or the Claim to it.

Q. *When were thoſe ſlaviſh Maxims of Hereditary Indefeazable Right and Prerogative, ſuperior to Law, firſt introduced?*

A. In the Time of *James* the Firſt; who by endeavouring to eſtabliſh them, laid the Foundation of all the Miſeries which have ſince happened to his Family; and it is the greateſt Security to the preſent Branch of it, that ſuch Doctrines which ſow the Seeds of Jealouſy between the King and his People, are by the preſent Eſtabliſhment quite exploded.

Q. *What do'ſt thou learn from thoſe Hiſtories?*

A. That a King of this Realm, in the full Poſſeſſion of the Affections of his People is greater than any Arbitrary Prince, and that the Nation can never be effectually undone but by a wicked Parliament; and laſtly, to be thankful to God that under our preſent moſt gracious King our Con-

Conſtitution is preſerv'd entire, tho' at the ſame time there are many Circumſtances which call Loudly for Vigilance.

Q. *What are thoſe?*

A. Such as have been the Fore-runners and Cauſes of the Loſs of Liberty in other Countries, Decay of Virtue, and Publick Spirit, Luxury and Extravagance in Expence, Venality and Corruption, in private and publick Affairs.

Q. *How comes there to be a Decay of Publick Spirit, when there is more than uſual a Deſire to ſerve The Publick?*

A. If a Deſire to live upon the Publick, be a Publick Spirit, there is enough of it at this Time, when Extravagance makes People crave more, and the Adminiſtration of a Publick Revenue (perhaps treble what it was before the Revolution) enables the Crown to give more than formerly.

Q. *What do'ſt thou fear from this?*

A. That ſuch as ſerve the Crown for Reward, may in Time ſacrifice the Intereſt of the Country to their Wants; that Greedineſs of publick Money may produce a ſlaviſh Complaiſance as long as the Crown can pay; and Mutiny when it cannot; and in general, that Motives of Self-Intereſt will prove an improper and weak Foundation for our Duty to our King and Country.

Q. *I much rejoice to ſee a Perſon of your Knowledge and Publick Spirit; therefore I aſk you what is the Sum and Subſtance of the Virtue of a good Citizen?*

A. The Love of our Country comprehends in it the Virtues of a good Citizen, as the Love of God thoſe of a good Chriſtian: It is the Love not only of One, but of Millions of Neighbours; not only of our Neighbours now living, but of them

and

and of their Poſterity. It is an Inſtinct as well as Duty of Nature; the very Soil from which as from a common Mother, Mankind are nouriſh'd and the laſt common Repoſitory of their dead Bodies, has been reputed amongſt human Creatures, as a Bond of Union; *Joſeph* comforted himſelf with his dying Breath, reflecting that his Bones ſhould reſt amongſt his Bretheren. I read of one *Themiſtocles* who, tho' he had been baniſhed from *Greece* and Hoſpitality, and receiv'd in *Perſia*, ordered his Corps to be carried back and buried by ſtealth in his own Country. All Nations ſink and riſe in proportion as this Virtue prevails. When I read the *Roman* Hiſtory I am tranſported with Joy, and a profound Reverence for thoſe Worthies who ſacrificed their Lives, and what was perhaps dearer to them, to the Love of their Country. Nor is our own Country deſtitute of Examples of ſuch Heroick Virtue, of which ſome have tranſmitted the glorious Fruits to their Poſterity; and ſuch as have fail'd of that, have attain'd to a glorious Immortality, and advanc'd the Temporal Felicity of Generations paſt and to come. The Love of our Country is both a Moral and Religious Duty.

Q. *How do'ſt thou prove That?*

A. The Love which we owe to all Mankind, is not only allow'd but enjoin'd, in greater Degrees to particular Societies, whereof we are Members, as Nations, Neighbours, Kindred, Families, and Children: There are many Precepts of the Examples in Scripture enforcing this Duty of the Love of our Country; and holy Men of Old, as they were endowed with a religious, ſeem'd proportionably fill'd with a Publick Spirit; the *Old Teſtament* is full of ſuch Examples: This was the ſhining Virtue of *Moſes*, and of all the Captains, Princes, and

Prophets

Prophets of God's People. One of the Books of the Prophets is a Lamentation for the Captivity and Deſolation of *Judah*; *Woe unto me* (ſaid *Mathias*, 2 Maccabees ii.) *wherefore was I born, to ſee the Deſolation of my People.* Then he and his Sons rent their Cloths and put on Sack-cloth and Mourning; *We are ready to die*, ſaid the young Men, *rather than tranſgreſs the Laws of our Country.* It is ſaid of *Judas Maccabeus*, *That he made the Jews* bold *and ready to die for the Laws of their Country.* This Virtue was more eminent in our Bleſſed Saviour than in any of the Sons of Men: He confin'd at firſt the Benefit of his Goſpel and Miracles to his own Country; he heals the Centurion's Servant upon the Motive of his being a Friend to the *Jewiſh* Nation; and moſt tender in his Lamentation over the approaching Deſolation of his Country, and his Interceſſion for it with his dying Breath. St. *Paul* could ev'n wiſh himſelf accurſed for his Countrymen, his Brethren, and Kinſmen after the Fleſh. And I am of Opinion, that the Decay of the Publick Spirit at this time is much owing to the Decay of Virtue, and that true Religion, which is always free from Bigotry and Superſtition, and a perſecuting Spirit.

Q. *What would'ſt thou do for thy Country?*

A. I would die to procure its Proſperity: And I would rather that my Poſterity were cut off, than that they ſhould be Slaves; but as Providence at preſent requires none of thoſe Sacrifices, I content myſelf to diſcharge the ordinary Duties of my Station, and to exhort my Neighbours to do the ſame.

Q. *What are the Duties of your Station?*

A. To endeavour as far as I am able, to preſerve the publick Tranquillity; and as I am a Freehoder, to

to give my Vote for the Candidate whom I judge moſt worthy to ſerve his Country: For if for any partial Motive I ſhould give my Vote for one unworthy, I ſhould think myſelf juſtly chargeable with his Guilt.

Q. *Thou haſt perhaps but one Vote of Five Hundred, and the Member perhaps one of Five Hundred more, then your ſhare of the Guilt is but ſmall?*

A. As he who aſſiſts at a Murder is guilty of Murder, ſo he who acts the loweſt Part in the Enſlaving his Country, is guilty of a much greater Crime than Murder.

Q. *Is Enſlaving one's Country a greater Crime than Murder?*

A. Yes: Inſomuch as the Murder of Human Nature is a greater Crime than the Murder of a Human Creature; or as he who debaſeth and rendereth miſerable the Race of Mankind, is more wicked than he who cutteth off an Individual.

Q. *Why is Enſlaving Mankind murdering Human Nature?*

A. Becauſe Mankind in a State of Slavery and Freedom is a different Sort of Creature; for Proof of this I have read what the *Greeks* were of old, and what they are now in a State of Slavery.

Q. *What is become of the Heroes, Philoſophers, Orators, and free Citizens of* Greece?

A. They are now Slaves to the *Great Turk.*

Q. *What is becsme of the* Scipio's *and* Cato's *of* Rome?

A. They ſing now on the *Engliſh* Stage.

Q. *Does not the Tranquillity occaſioned by abſolute Monarchy make the Country thrive?*

A. Peace and Plenty are not the genuine Fruits of abſolute Monarchy; for abſolute Monarchies are more ſubject to Convulſions, than free Governments;

ments, and Slavery turneth the fruitful Plains into a Deſart; whereas Liberty, like the Dew from Heaven, fructifieth the barren Mountains. This I have learn'd from Travellers, who have viſited Countries in both Conditions; therefore as I ſaid before, I ſhould reckon myſelf guilty of the greateſt Crime human Nature is capable of, if I were any ways acceſſary to the enſlaving my Country; tho' I have but one Vote, many Unites make a Number, and if every Elector ſhould Reaſon after the ſame manner, that he has but one; what muſt become of the whole? a Law of great Conſequence, and the Election of the Member who voteth for that Law, may be both carried by one Vote; great and important Services for the Liberties of their Country, have been done by ordinary Men: I have read, that the Inſtitution of the Tribunes of *Rome*, or the whole Power of the Commons, was owing to a Word ſpoke in ſeaſon by a common Man.

Q. *Is it not lawful then to take a Bribe from a Perſon otherwiſe worthy to ſerve his Country?*

A. No more than for a Judge to take a Bribe for a Righteous Sentence; nor is it any more lawful to corrupt, than to commit Evil that Good may come of it: Corruption converts a good Action into Wickedneſs. Bribery of all Sorts is contrary to the Law of God; it is a heinous Sin, often puniſhed with the ſevereſt Judgmenrs; it involves in it the Sin of Perjury as the Law ſtands now, and is beſides the greateſt Folly and Madneſs.

Q. *How is it contrary to the Law of God?*

A. The Law of God ſaith expreſsly, *Thou ſhall not wreſt Judgment*; *Thou ſhalt not take a Gift*: If it is a Sin in a Judge, it is much more in a Law-

giver

giver, or an Elector; becauſe the Miſchiefs occaſioned by the firſt reach only to Individuals, that of the laſt may affect whole Nations, and even the Generations to come. The Pſalmiſt deſcribing the Wicked, ſaith, *his right Hand is full of Bribes:* The Prophet deſcribing the Righteous, tells us, *he ſhaketh his Hands from holding a Bribe: Samuel* juſtifying his Innocence, appeals to the People, *of whoſe Hands have I taken a Bribe?* Then as to divine Vengeance, holy *Job* tells us, *that God ſhall deſtroy the Tabernacle of Bribery. Achan*'s Avarice who had appropriated to his own Uſe the golden Wedge and the *Babyloniſh* Garment, brought the Judgments of God upon the whole People, ſo that they fled before their Enemies, till the Criminal was diſcovered and ſtoned to Death. The Leproſy adhered to *Gehazi* (the Servant of *Eliſha*) and his Houſe for ever, for taking a Bribe from *Naaman*, a rich Miniſter of a great Prince: Therefore he that taketh a Bribe may juſtly expect what is threatned in Holy Writ; *He ſhall not proſper in his Way, neither ſhall his Subſtance continue; his Silver and Gold ſhall not be able to deliver him in the Day of the Wrath of the Lord.*

Q. *Why is he that taketh a Bribe guilty of the Sin of Perjury?*

A. Becauſe he ſweareth,

I A. B. *do ſwear* (or being one of the People called Quakers, *I* A. B. *do ſolemnly affirm*) *I have not receiv'd, nor had by my Self, or any Perſon whatſoever in Truſt for me, or for my Uſe and Benefit, directly or indirectly, any Sum or Sums of Money, Office, Place, or Imployment, Gift, or Reward, or any Promiſe or Security for any Money, Office, Imployment, or Gift, in order to give my Vote at this Election, and that I have not before been polled at this Election.*

Q. *What thinkeſt thou of thoſe who are bribed by Gluttony and Drunkenneſs.*

A. That they are viler than *Eſau* who ſold his Birth-right for a Meſs of Porridge.

Q. *Why is taking a Bribe Folly or Madneſs?*

A. Becauſe I muſt refund Ten-fold in Taxes of what I take in Election; and the Member who bought me, has a fair Pretence to ſell me, nor can I in ſuch a Caſe have any juſt Cauſe of Complaint.

Q. *What wilt thou ſay then to the Candidate that offers thee a Bribe?*

A. I will ſay, "Thy Money periſh with thee; "as thou art now purchaſing thy Seat in Parlia- "ment, I have juſt Reaſon to ſuſpect that thou "reſolveſt to ſell thy Vote; what thou offereſt "and what thou promiſeth may be the Price of "the Liberty of my Country: I will not only "reject thy Bribe with Diſdain, but will vote "againſt thee.

Q. *Is not the Juſtice of a King, ſufficient Security for the Liberty of the People?*

A. The People ought to have more Security for all that is valuable in the World, than the Will of a mortal and fallible Man; a King of *Britain* may make as many Peers, and ſuch, as he pleaſeth; therefore the laſt and beſt Security for the Liberties of the People, is a Houſe of Commons Genuine and Independant.

Q. *What meaneſt thou by a Genuine Houſe of Commons?*

A. One that is the lawful Iſſue of the People, and no Baſtard.

Q. *How is a Baſtard Houſe of Commons produc'd?*

A. When

A. When the People by Terror, Corruption, or other indirect Means, chuſe ſuch as they otherwiſe would not chuſe; when ſuch as are fairly choſen, are not returned; when ſuch as are returned, are turn'd out by partial Votes in controverted Elections, and others not fairly choſen ſet in their Places.

Q. *How may a Houſe of Commons become dependant?*

A. When the Freedom of Voting is deſtroy'd by Threatnings, Promiſes, Puniſhments, and Rewards by the open Force of the Government, or the Inſults of the Populace; but above all by private Influence; for they who are armed with the Power of the Crown, have many ways of gratifying ſuch as are ſubſervient to their Deſigns, and many ways of oppreſſing ſuch as oppoſe them, both within the Bounds of the Law.

Q. *Can a King have a more faithful Council than a Houſe of Commons, which ſpeaketh the Senſe of the People?*

A. None. For they will not only give him impartial Council, but will powerfully and chearfully aſſiſt him to execute what they adviſe.

Q. *What are the Marks of a Perſon worthy to ſerve his Country in Parliament?*

A. The Marks of a good Ruler given in Scripture, will ſerve for a Parliament-man; *Such as rule over you ſhall be Men of Truth, hating Covetouſneſs, they ſhall not take a Gift, they ſhall not be afraid of the Face of a Man*, Deut. xvi. therefore I conclude, That the Marks of a good Parliament-man are Riches with Frugality, Integrity, Courage, being well affected to the Conſtitution, Knowledge of the State of the Country, being prudently frugal of the Money, careful of the Trade, and zealous over the Liberties of the People, having ſtuck to the Intereſts

of their Country in perilous Times, and being aſſiduous in attendance.

Q. *Who is moſt likely to take a Bribe?*

A. He who offereth one.

Q. *Who is likely to be frugal of the People's Money?*

A. He who puts none of it in his own Pocket.

Q. *You ſeem by this to be averſe from chuſing ſuch as accept of Places and Gratuities from the Crown, what is your Reaſon for this Partiality?*

A. I am far from thinking that a Man may not ſerve his King, and Country faithfully at the ſame time: nay their Intereſts are inſeparable. Mr. Such-an one, my Lord's Steward is a very honeſt Man, and yet if I had any Affairs to ſettle with my Lord, I would chuſe my Neighbour for a Referree rather than my Lord's Steward.

Q. *Why is Frugality of the People's Money ſo neceſſary at this time?*

A. Becauſe they have run out much, and are ſtill much in Debt: My Father and I have paid our ſhare of One Hundred Millions, and I have heard there are near Fifty more to pay: I grudge not this prodigious Expence, as far as it has been the neceſſary Price of Liberty; but as it would grieve me much to ſee this Bleſſing raviſh'd from me which has coſt me ſo dear; ſo on the other hand I think it expedient to ſave, now the Affair is over, and the Government ſettled.

Q. *Who are thoſe who are careful of the Trade of the Nation?*

A. Such as are willing to keep it free from all vexatious Interruptions by Inſpections, Entering into Houſes, Seizures, Suits, and the Oppreſſion of Tax-gatherers, as much as poſſible; ſuch as are willing to take off the burdenſome Duties which encreaſe

encreaſe the Expence of the Workman, and conſequently the Price of our Manufactures.

Q. *But as you have a Freehold, would you not be willing to be excus'd from paying two Shillings in the Pound by laying Exciſes upon other Parts of our Conſumptions?*

A. No doubt but every Landed Man would be glad to be free from paying Two Shillings in the Pound; but at the ſame time I would not raiſe by another Tax Two Shillings in the Pound, nor One Shilling in the Pound for a Perpetuity. For Parliaments who have no more to give, may be diſappointed in the Redreſs of their Grievances. Beſides, I would not be deluded by an Impoſſibility; for if my Tenant has any new Tax laid upon him, I am afraid he will not pay me ſo much Rent; ſo that the new Tax muſt ſtill affect Land. Then it is utterly impoſſible to raiſe by Exciſes what ſhall be equivalent to Two Shillings in the Pound without the Ruin of Trade; for the Exciſes which are ſettled already, generally ſpeaking, raiſe double the Duty upon the People, of what they bring into the Government.

Q. *How can'ſt thou prove that?*

A. By Experience of ſeveral Exciſes, as of Leather, Candles, Soap, *&c.* Whatever is brought into the Publick by thoſe Exciſes, is raiſed double upon the People; therefore if a Million of Money, or what is equivalent to Two Shillings in the Pound, were levy'd by Exciſe, it would be Two Millions upon the Excis'd Commodities, which muſt deſtroy every Subject of Trade in *Britain*.

Q. *Why do'ſt thou inſiſt, That a Knowledge of the State of the Country is a neceſſary Qualification for a Parliament-man?*

A. Becauſe this is a Qualification, of late, very

much unheeded: I have heard that there are many Corporations that never ſaw their Members.

Q. *Is then a Writ of Parliament only a* Conge d'Elire *for a Biſhop, where the King nominates?*

A. God forbid; the Crown is never to meddle in an Election.

Q. *Why is aſſiduous Attendance ſo neceſſary?*

A. Becauſe a Parliament-man is entruſted with the Lives, Liberties and Properties of the People, which have often been endangered by the Non-attendance of many Members; becauſe if Repreſentatives do not attend, I may have a Law impos'd upon me, to which I had no opportunity of giving my Aſſent.

Q. *Thou haſt prudently and juſtly reſolv'd to promote, to the utmoſt of thy Power, the Publick Tranquility; what are the Advantages thou propoſeſt from that?*

A. All the Advantages reſulting from Political Society depend upon the Publick Tranquility: Beſides, by Publick Tranquility, Armies, which are the Mark of Diſtruſt of the Affections of the People, may be Diſbanded.

Q. *Why do'ſt thou not love Armies in Time of Peace?*

A. Becauſe Armies have overturn'd the Liberties of moſt Countries; and all who are well affected to Liberty, ever hated them; becauſe they are ſubject to an implicit Obedience to their Officers, and to a Law of their own; becauſe they are ſo many luſty Men taken from Work, and maintain'd at an extravagant Expence upon the Labour of the reſt; becauſe they are many Ways burdenſome to the People in their Quarters even under the beſt Diſcipline, eſpecially in dear Countries; becauſe there are ſo many more Preferments in the Hands of Deſigning

ſigning Miniſters; and laſtly, becauſe the King will never be deny'd an Army as great as he pleaſeth, when it is neceſſary.

Q. *Thou rightly judgeſt of thy Happineſs in being a Member of a Political Society, govern'd by Laws, to which the People give their Conſent: Thou haſt been likewiſe well inſtructed in the fundamental Laws of the Government, and art well aware of the wicked and abominable Practices that undermine, and are likely to overturn the Conſtitution: Be thou likewiſe verily perſuaded that the equitable and fundamental Laws of a Nation are, in a ſound Senſe, ſtampt with a Divine Authority; and that the good Order, Peace, and Happineſs of the Society is firmly connected with a ſtrict Obſervance of them. That the Proſperity of Nations depend upon their Virtue, not only as an effect upon its Natural Cauſe, but by the immutable Appointment of Divine Juſtice, by which Political Societies muſt receive their Rewards and Puniſhments in this World, ſince they have no Being in the next; conſequently the Threatnings and Promiſes which occur in the Old Teſtament are, in a proper Senſe, as applicable to other Nations as the* Iſraelites, *therefore thou and all the People of this Land may ſuppoſe that God Almighty ſpeaketh to them as he ſpoke by* Moſes *unto the* Iſraelites, Deut. xxviii. 1. And it ſhall come to paſs, if thou ſhalt hearken diligently unto the Voice of the Lord thy God, to obſerve and do all his Commandments, (*that is the Laws of their Conſtitution*) which I command thee this Day; that the Lord thy God will ſet thee on high above all Nations of the Earth, *&c. Verſe* 15. But it ſhall come to paſs, if thou wilt not hearken unto the Voice of the Lord thy God, to obſerve to do all his Commandments and his Statutes which I command thee this Day; that all theſe Curſes ſhall come upon

thee and overtake thee. Curſed ſhalt thou be in the City, and Curſed ſhalt thou be in the Field. Curſed ſhall be thy Baſket and thy Store. Curſed ſhall be the Fruit of thy Body, and the Fruit of thy Land, the Increaſe of thy Kine, and the Flocks of thy Sheep. Curſed ſhalt thou be when thou comeſt in, and Curſed ſhalt thou be when thou goeſt out, *&c. &c.*

ΓΝΩΘΙ ΣΕΑΥΤΟΝ. Know Yourſelf.

WHAT am I? how produc'd? and for what end?
Whence drew I being? to what period tend?
Am I th'abandon'd orphan of blind chance;
Dropt by wild atoms in diſorder'd dance?
Or from an endleſs chain of cauſes wrought?
And of unthinking ſubſtance, born with thought?
By motion which began without a cauſe,
Supreamly wiſe, without deſign or laws.
Am I but what I ſeem, meer fleſh and blood;
A branching channel, with a mazy flood?
The purple ſtream that through my veſſels glides,
Dull and unconſcious flows like common tides:
The pipes through which the circling juices ſtray,
Are not that thinking I, no more than they:
This frame, compacted with tranſcendent ſkill,
Of moving joints obedient to my will;
Nurs'd from the fruitful glebe, like yonder tree,
Waxes and waſtes; I call it mine, not me:
New matter ſtill the mould'ring maſs ſuſtains,
The manſion chang'd, the tenant ſtill remains:

And

And from the fleeting ſtream repair'd by food,
Diſtinct, as is the ſwimmer from the flood.
What am I then? ſure, of a nobler birth,
Thy parents right, I own a mother, earth;
But claim ſuperior lineage by my SIRE,
Who warm'd th'unthinking clod with heavenly fire:
Eſſence divine, with lifeleſs clay allay'd,
By double nature, double inſtinct ſway'd;
With look erect, I dart my longing eye,
Seem wing'd to part, and gain my native ſky;
I ſtrive to mount, but ſtrive, alas! in vain,
Ty'd to this maſſy globe with magick chain.
Now with ſwift thought I range from pole to pole,
View worlds around their flaming centers roll:
What ſteady powers their endleſs motions guide,
Thro' the ſame trackleſs paths of boundleſs void!
I trace the blazing comet's fiery trail,
And weigh the whirling planets in a ſcale:
Thoſe godlike thoughts, while eager I purſue,
Some glitt'ring trifle offer'd to my view,
A gnat, an inſect, of the meaneſt kind,
Eraſe the new born image from my mind;
Some beaſtly want, craving, importunate,
Vile as the grinning maſtiffs at my gate,
Calls off from heav'nly truth this reas'ning me,
And tells me I'm a brute as much as he.
If on ſublimer wings of love and praiſe,
My ſoul above the ſtarry vault I raiſe,
Lur'd by ſome vain conceit, or ſhameful luſt,
I flag, I drop, and flutter in the duſt.
The tow'ring lark thus from her lofty ſtrain,
Stoops to an emmet, or a barley grain.
By adverſe guſts of jarring inſtincts toſt,
I rove to one, now to the other coaſt;
To bliſs unknown my lofty ſoul aſpires,
My lot unequal to my vaſt deſires.

As 'mongſt the hinds a child of royal birth
Finds his high pedigree by conſcious worth;
So man, amongſt his fellow brutes expos'd,
Sees he's a king, but 'tis a king depos'd:
Pity him, beaſts! you by no law confin'd,
Are barr'd from devious paths by being blind;
Whilſt man, through op'ning views of various ways
Confounded, by the aid of knowledge ſtrays;
Too weak to chooſe, yet chooſing ſtill in haſte,
One moment gives the pleaſure and diſtaſte;
Bilk'd by paſt minutes, while the preſent cloy,
The flatt'ring future ſtill muſt give the joy.
Not happy, but amus'd upon the road,
And (like you) thoughtleſs of his laſt abode,
Whether next ſun his being ſhall reſtrain,
To endleſs nothing, happineſs, or pain.
Around me, lo, the thinking thoughtleſs crew,
(Bewilder'd each) their different paths purſue;
Of them I aſk the way; the firſt replies,
Thou art a god; and ſends me to the ſkies.
Down on this turf (the next) thou two-legg'd beaſt,
There fix thy lot, thy bliſs, and endleſs reſt:
Between thoſe wide extreams the length is ſuch,
I find I know too little or too much.
"Almighty pow'r, by whoſe moſt wiſe command,
"Helpleſs, forlorn, uncertain here I ſtand;
"Take this faint glimmering of thy ſelf away,
"Or break into my ſoul with perfect day!
This ſaid, expanded lay the ſacred text,
The balm, the light, the guide of ſouls perplext:
Thus the benighted traveller that ſtrays
Through doubtful paths, enjoys the morning rays;
The nightly miſt, and thick deſcending dew,
Parting, unfold the fields, and vaulted blue.
"O truth divine! enlightened by thy ray,
"I grope and gueſs no more, but ſee my way;

"Thou

" Thou clearedſt the ſecret of my high deſcent,
" And told me what thoſe myſtic tokens meant;
" Marks of my birth, which I had worn in vain,
" Too hard for worldly ſages to explain;
" Zeno's were vain, vain Epicurus' ſchemes,
" Their ſyſtems falſe, deluſive were their dreams;
" Unſkill'd my twofold nature to divide,
" One nurs'd by pleaſure, and one nurs'd by pride:
" Thoſe jarring truths which human art beguile,
" Thy ſacred page thus bid me reconcile.
Offſpring of God, no leſs thy pedigree,
What thou once wer't, art now, and ſtill may be,
Thy God alone can tell, alone decree;
Faultleſs thou dropt from his unerring ſkill,
With the bare pow'r to ſin, ſince free of will:
Yet charge not with thy guilt, his bounteous love,
For who has power to walk, has power to rove;
Who acts by force impell'd, can nought deſerve;
And wiſdom ſhort of infinite, may ſwerve.
Born on thy new-imp'd wings, thou took'ſt thy flight,
Left thy creator, and the realms of light;
Diſdain'd his gentle precept to fulfil;
And thought to grow a god by doing ill:
Though by foul guilt thy heav'nly form defac'd,
In nature chang'd from happy manſions chac'd,
Thou ſtill retain'ſt ſome ſparks of heav'nly fire,
Too faint to mount, yet reſtleſs to aſpire;
Angel enough to ſeek thy bliſs again,
And brute enough to make thy ſearch in vain.
The creatures now withdraw their kindly uſe,
Some fly thee, ſome torment, and ſome ſeduce;
Repaſt ill ſuited to ſuch diff'rent gueſts,
For what thy ſenſe deſires, thy ſoul diſtaſtes;
Thy luſt, thy curioſity, thy pride,
Curb'd, or deferr'd, or balk'd, or gratify'd,

Rage

Rage on, and make thee equally unbleſs'd,
In what thou want'ſt, and what thou haſt poſſeſt;
In vain thou hop'ſt for bliſs on this poor clod,
Return, and ſeek thy father, and thy God:
Yet think not to regain thy native ſky,
Born on the wings of vain philoſophy;
Myſterious paſſage! hid from human eyes;
Soaring you'll ſink, and ſinking you will riſe:
Let humble thoughts thy wary footſteps guide,
Regain by meekneſs what you loſt by pride.

HUYGENS *de Ratiociniis in Ludo Aleæ:*

Tranſlated into *Engliſh* by Dr. ARBUTHNOT.

The PREFACE.

IT is thought as neceſſary to write a Preface before a Book, as it is judged civil, when you invite a Friend to Dinner, to proffer him a Glaſs of Hock beforehand for a Whet: And this being maim'd enough for want of a Dedication, I am reſolved it ſhall not want an Epiſtle to the Reader too. I ſhall not take upon me to determine, whether it is lawful to play at Dice or not, leaving that to be diſputed betwixt the Fanatick Parſons *and the* Sharpers; *I am ſure it is lawful to deal with Dice as with other Epidemic Diſtempers; and I am confident that the writing a Book about it, will contribute as little towards its Encouragement, as Fluxing and Precipitates do to Whoring.*

It will be to little purpoſe to tell my Reader, of how great Antiquity the playing at Dice is, I will only let him know, that by the Aleæ Ludus, *the Antients comprehended all Games, which were ſubjected to the Determina-*

Determination of mere Chance; this ſort of Gaming was ſtrictly forbid by the Emperor Juſtinian, Cod. Lib. 3. Tit. 43. *under very ſevere Penalties; and* Phocius Nomocan. Tit. 9. Cap. 27. *acquaints us, that the Uſe of this was altogether denied the Clergy of that time.* Seneca *ſays very well,* Aleator quantò in arte eſt melior, tantò eſt nequior; *That by how much the one is more ſkilful in Games, by ſo much he is the more culpable; or we may ſay of this, as an ingenious Man ſays of Dancing, that to be extraordinary good at it, is to be excellent in a Fault; therefore I hope no body will imagine I had ſo mean a Deſign in this, as to teach the Art of Playing at Dice.*

A great part of this Diſcourſe is a Tranſlation from Monſ. Huygens's *Treatiſe,* De ratiociniis in ludo Aleæ; *one, who in his Improvements of Philoſophy, has but, one Superior, and I think few or no Equals. The whole I undertook for my own Divertiſement, next to the Satisfaction of ſome Friends, who would now and then be wrangling about the Proportions of Hazards in ſome Caſes that are here decided. All it required was a few ſpare Hours, and but little Work for the Brain; my Deſign in publiſhing it, was to make it of more general Uſe, and perhaps perſuade a raw Squire, by it, to keep his Money in his Pocket; and if, upon this account, I ſhould incur the Clamours of the Sharpers, I do not much regard it, ſince they are a ſort of People the World is not bound to provide for.*

You will find here a verydplain and eaſy Method of the Calculation of the Hazars of Game, which a Man may underſtand, without knowing the Quadratures of Curves, *the Doctrine of* Series's, *or the Laws of* Concentripetation *of Bodies, or the Periods of the* Satellites *of* Jupiter; *yea, without ſo much as the Elements of* Euclid. *There is nothing required for the comprehending the whole, but common Senſe and practical*

tical Arithmetick; ſaving a few Touches of Algebra, *as in the firſt Three Propoſitions, where the Reader, without ſuſpicion of Popery, may make uſe of a ſtrong implicit Faith; tho' I muſt confeſs, it does not much recommend itſelf to me in theſe Purpoſes; for I had rather he would enquire, and I believe he will find the Speculation not unpleaſant.*

Every Man's Succeſs in any Affair is proportional to his Conduct and Fortune. Fortune (in the ſenſe of moſt People) ſignifies an Event which depends on Chance, agreeing with my Wiſh; and Misfortune ſignifies ſuch an one, whoſe immediate Cauſes I don't know, and conſequently can neither foretel nor produce it (for it is no Hereſy to believe, that Providence ſuffers ordinary matters to run in the Channel of ſecond Cauſes). Now I ſuppoſe, that all a wiſe Man can do in ſuch a Caſe is, to lay his Buſineſs on ſuch Events, as have the moſt powerful ſecond Cauſes, and this is true both in the great Events of the World, and in ordinary Games. It is impoſſible for a Die, with ſuch determined force and direction which makes it fall on ſuch a determined ſide, only I don't know the force and direction which makes it fall on ſuch a determin'd ſide, and therefore I call that Chance, which is nothing but want of Art; that only which is left to me, is to wager where there are the greateſt number of Chances, and conſequently the greateſt probability to gain; and the whole Art of Gaming, where there is any thing of Hazard, will be reduced to this at laſt, viz. *in dubious Caſes to calculate on which ſide there are moſt Chances; and tho' this can't be done in the midſt of Game preciſely to an Unit, yet a Man who knows the Principles, may make ſuch a Conjecture, as will be a ſufficient direction to him; and tho' it is poſſible if there are any Chances againſt him at all, that he may loſe, yet when he chuſeth the ſafeſt ſide,*

ſide, he may part with his Money with more content (if there can be any at all) in ſuch a Caſe.

I will not debate, whether one may engage another in a diſadvantageous Wager. Games may be ſuppos'd to be a tryal of Wit as well as Fortune, and every Man, when he enters the Liſts with another, unleſs out of Complaiſance, takes it for granted, his Fortune and Judgment are, at leaſt, equal to thoſe of his Play-Fellows; but this I am ſure of, that falſe Dice, Tricks of Leger-de-main, &c. *are inexcuſable, for the queſtion in Gaming is not, Who is the beſt Jugler?*

The Reader may here obſerve the Force of Numbers, which can be ſucceſsfully applied, even to thoſe things, which one would imagine are ſubject to no Rules. There are very few things which we know, which are not capable of being reduc'd to a Mathematical Reaſoning; and when they cannot, it's a ſign the Knowledge of them is very ſmall and confus'd; and where a Mathematical reaſoning can be had, it's as great folly to make uſe of any other, as to grope for a thing in the Dark, when you have a Candle ſtanding by you. I believe the Calculation of the Quantity of Probability might be improved to a very uſeful and pleaſant Speculation, and applied to a great many Events which are accidental, beſides thoſe of Games; only theſe Caſes would be infinitely more confus'd, as depending on Chances which the moſt part of Men are ignorant of; and as I have hinted already, all the Politicks in the World, are nothing elſe but a kind of Analyſis of the Quantity of Probability in caſual Events, and a good Politician ſignifies no more, but one who is dextrous at ſuch Calculations; only the Principles which are made uſe of in the Solution of ſuch Problems, can't be ſtudied in a Cloſet, but acquired by the Obſervation of Mankind.

There is likewiſe a Calculation of the Quantity of Probability founded on Experience, to be made uſe of

in

in Wagers about any thing; it is odds if a Woman is with Child, *but it ſhall be a* Boy; *and if you would know the juſt odds, you muſt conſider the Proportion in the Bills that the Males bear to the Females: The Yearly Bills of Mortality are obſerved to bear ſuch Proportion to the live People as* 1 *to* 30, *or* 26; *therefore it is an even Wager, that one of thirteen, dies within a Year (which may be a good Reaſon, tho' not the true, of that fooliſh piece of Superſtition,) becauſe, at this rate, if* 1 *out of* 26 *dies, you are no loſer. It is but* 1 *to* 18 *if you meet a* Parſon *in the Street, that he proves to be a* Non-Juror, *becauſe there is but* 1 *of* 36 *that are ſuch. It is hardly* 1 *to* 10, *that a* Woman *of Twenty Years old has her* Maiden-head, *and almoſt the ſame Wager, that a* Town-Spark *of that Age has not been* clap'd. *I think a Man might venture ſome odds, that* 100 *of the* Gens d'arms *beats an equal Number of* Dutch Troopers; *and that an* Engliſh Regiment *ſtands its ground as long as another, making Experience our Guide in all theſe Caſes and others of the like Nature.*

But there are no caſual Events, which are ſo eaſily ſubjected to Numbers, as thoſe of Games; and I believe, there the Speculation might be improved ſo far, as to bring in the Doctrine of the Series's *and* Logarithms. *Since Gaming is become a Trade, I think it fit the Adventurers ſhould be upon the Square; and therefore in the Contrivance of Games there ought to be a ſtrict Calculation made uſe of, that they mayn't put one Party in more probability to gain than another; and likewiſe, if a Man has a conſiderable Venture; he ought to be allowed to withdraw his Money when he pleaſes, paying according to the Circumſtances he is then in: And it were eaſy in moſt Games to make Tables, by inſpection of which, a Man might know what he was either to pay or receive, in any Circumſtances*

ſtances he is then in: And it were eaſy in moſt Games to make Tables, by Inſpection of which, a Man might know what he was either to pay or receive, in any Circumſtances you can imagine, it being convenient to ſave a part of one's Money, rather than venture the loſs of it all.

I ſhall add no more, but that a Mathematician will eaſily perceive, it is not put in ſuch a Dreſs as to be taken notice of by him, there being abundance of Words ſpent to make the more ordinary ſort of People underſtand it.

FOR the ſake of thoſe who are not vers'd in *Mathematics*, I have added the following Explanation of *Signs*. = *Equal*. + *More*, or to be added. — *Leſs*, or to be ſubtracted. × *Multiplied*. ÷ *Divided*. *Example*, $3\times4+3-1=15=\frac{5}{9}a$, is to be read thus; 3 multiplied in 4, more by 3, leſs by 1, is equal to 14, which is equal to 5 ninth parts of *a*.

ALTHO' the Events of Games, which Fortune ſolely governs, are uncertain, yet it may be certainly determin'd, how much one is more ready to loſe than gain. For *Example*: If one ſhould wager, at the firſt throw with one Die, to throw ſix, it's an accident if he gains or not; but by how much it's more probable he will loſe than gain, is really determin'd by the Nature of the Thing, and capable of a ſtrict Calculation. So likewiſe if I ſhould play with another on this Condition, that the Victory ſhould be to the three firſt Games, and I had gain'd one already, it is ſtill uncertain who ſhall gain the third; yet by a demonſtrative

Reaſoning, I can eſtimate both the Value of his Expectation and mine, and conſequently (if we agree to leave the Game imperfect) determine how great a ſhare of the Stakes belong to me, and how much to my Play-fellow; or if any were deſirous to take my Place, at any rate I ought to ſell it. Hence may ariſe innumerable Queries among two, three, or more Gameſters: And ſince the Calculation of theſe things is a little out of the common Road, and can be oft-times apply'd to good Purpoſe, I ſhall briefly here ſhew how it is to be done, and afterwards explain thoſe things which belong properly to the Dice.

In both Caſes I ſhall make uſe of this Principle, *One's Hazard or Expectation to gain any thing, is worth ſo much, as, if he had it, he could purchaſe the like Hazard or Expectation again in a juſt and equal Game.*

For *Example*, if one, without my Knowledge, ſhould hide in one hand 7 Shillings, and in his other 3 Shillings, and put it to my choice which Hand I would take, I ſay this is as much worth to me, as if he ſhould give me 5 Shillings; becauſe, if I have 5 Shillings, I can purchaſe as good a Chance again, and that in a fair and juſt Game.

Prop. I. *If I expect* a *or* b, *either of which, with equal probability, may fall to me, then my Expectation is worth* $\frac{a+b}{2}$, *that is, the half Sum of* a *and* b.

THAT I may not only demonſtrate, but likewiſe inveſtigate this Rule, ſuppoſe the Value of my Expectation be x; by the former Principle having x, I can purchaſe as good an Expectation again in a fair and juſt Game. Suppoſe then I play with another on theſe terms, That every one ſtakes

x,

x, and the Gainer give to the Loſer a, this Game is juſt, and it appears, that at this rate, I have an equal hazard either to get a if I loſe the Game, or $2x-a$ if I again; for in this caſe I get $2x$, which are the Stakes, out of which I muſt pay the other a; but if $2x-a$ were worth b, then I have an equal hazard to get a or b; therefore making $2x-a=b$, $x=\frac{a+b}{2}$ which is the Value of my Expectation. The Demonſtration is eaſy; for having $\frac{a+b}{2}$, I can play with another who will ſtake $\frac{a+b}{2}$ againſt it, on this Condition, that the Gainer ſhould give to the Loſer a; by this means I have an equal Expectation to get a if I loſe, or b if I win; for in the laſt caſe I get $a+b$ the Stakes, out of which I muſt pay a to my Play-fellow.

In *Numbers*: if I had an equal hazard to get 3 or 7, then by this Propoſition, my Expectation is worth 5, and it is certain, having 5, I may have the ſame Chance; for if I play with another, ſo that every one ſtakes 5, and the Gainer pay to the Loſer 3, this is a fair way of gaming; and it is evident I have an equal hazard to get 3 if I loſe, or 7 if I gain.

Prop. II. *If I expect* a, b, *or* c, *either of which, with equal facility, may happen, then the Value of my Expectation is* $\frac{a+b+c}{3}$, *or the third part of the Sum of* a, b, *and* c.

FOR the Inveſtigation of which, ſuppoſe x be the value of my Expectation; then x muſt be ſuch, as I can purchaſe with it the ſame Expectation in a juſt Game: Suppoſe the Conditions of the Game

be, that playing with two others, each of us ſtakes x, and I bargain with one of the Gameſters, if I win, to give him b, and he ſhall do the ſame to me; but with the other, that if I gain, I ſhall give him c, and *vice verſâ*; this is fair play: And here I have an equal hazard to get b, if the firſt win, c if the ſecond, or $3x-b-c$ if I gain myſelf; for then I get $3x$, *viz.* the Stakes, of which I give the one b and the other c; but if $3x-b-c$ be equal to a, I have an equal Expectation of a, b, or c; therefore making $3x-b-c=a$, $x=\frac{a+b+c}{3}$, which is the Value of my Expectation. After the ſame Method you will find, if I had an equal hazard to get a, b, c, or d, the Value of my Expectation $\frac{a+b+c+d}{4}$, that is the fourth part of the Sum of a, b, c, and d, &c.

Prop. III. *If the number of Chances, by which* a *falls to me, be* p, *and the number of Chances, by which* b *falls, be* q, *and ſuppoſing all the Chances do happen with equal facility, then the Value of my Expectation is* $\frac{pa+bq}{p+q}$; i. e. *the Product of* a *multiplied in the number of its Chances added to the Product of* b, *multiplied into the number of its Chances, and the Sum divided by the number of Chances both of* a *and* b.

SUppoſe, as before, x be the Value of my Expectation; then if I have x, I muſt be able to purchaſe with it that ſame Expectation again in a fair Game: For this I ſhall take as many Play-fellows, as, with me, make up the number of $p+q$, of which let every one ſtake x, ſo the whole Stake will be $px+qx$, and every one plays with equal hopes of winning; with as many of my Fellow-

Gameſters

Gameſters as the Number q ſtands for, I make the bargain one by one, that whoever of them gains ſhall give me b, and if I win, I ſhall do ſo to them; with every one of the reſt of the Gameſters, whoſe Number is $p - 1$, I make this bargain, that whoever of them gains, ſhall give me a, and I ſhall give every one of them as much, if I gain: It's evident this is fair play; for no Man here is injur'd; and in this caſe I have q Expectations to gain b, and $p - 1$ Expectations to gain a, and 1 Expectation (*viz.* when I win myſelf) to get $px + qx - bq - ap + a$; for then I am to deliver b to every one of the q Players, and a to every one of the $p - 1$ Gameſters, which makes $qb + pa - a$; if therefore $qx + bx - bq - ap + a$ were equal to a, I would have p Expectations of a (ſince juſt now I had $p - 1$ Expectations of it) and q Expectations of b, and ſo would have juſt come to my firſt Expectation; therefore putting $px + qx - bq - ap + a = a$, and then is $x = \frac{ap + bq}{p + q}$.

In *Numbers:* If I had 3 Chances to gain for 13, and 2 for 8, by this Rule, my hazard is worth 11; for 13 multiplied by 3 gives 39, and 8 by 2, 16, theſe two added, make 55, divided by 5 is 11; and I can eaſily ſhew, if I have 11, I can come to the like Expectation again; for playing with four others, and every one of us ſtaking 11, with two of them I make this bargain, that whoever gains ſhall give me 8, and I ſhall too ſo to them; with the other two I make this bargain, that whoever gains ſhall give me 13, and I them as much if I gain, and 3 Expectations to get 13, *viz.* if either I or any of the other two gain; for in this caſe I gain the Stakes, which are 55, out of which I am oblig'd to give the firſt

two 8, and the other two 13, and ſo there remains 13 for myſelf.

Prop. IV. *That I may come to the Queſtion propos'd, viz. The making a juſt Diſtribution amongſt Gameſters, when their Hazards are unequal; we muſt begin with the moſt eaſy Caſes.*

SUppoſe then I play with another, on condition that he who wins the three firſt Games ſhall have the Stakes, and that I have already gain'd two, I would know if we agree to break off the Game, and part the Stakes juſtly, how much falls to my ſhare.

The firſt thing we muſt conſider in ſuch Queſtions is the number of Games that are wanting to both: For *Example*, if it had been agreed betwixt us, that he ſhould have the Stakes who gain'd the firſt 20 Games, and if I had gain'd already 19, and my Fellow-Gameſter but 18, my hazard is as much better than his in that caſe, as in this propoſed, *viz.* When of 3 Games I have 2, and he but one, becauſe in both caſes there's 2 wanting to him, and 1 to me.

In the next place, to find the portion of the Stakes due to each of us, we muſt conſider what would happen if the Game went on; it is certain, if I gain the firſt Game, I get the Stake, which I call a; but if he gain'd, both our Lots would be equal, and ſo there would fall to each of us $\frac{1}{2}a$; but ſince I have an equal hazard to gain or loſe the firſt Game, I have an equal Expectation to gain a, or $\frac{1}{2}a$, which, by the firſt *Propoſition*, is as much worth as the half Sum of both; *i. e.* $\frac{1}{4}a$, ſo there is left to my Fellow-Gameſter $\frac{1}{4}a$; from whence it follows, that he who would buy my Game ought to pay me for it $\frac{3}{4}a$; and therefore, he who undertakes

to

to gain one Game before another gains two, may wager 3 to 1.

Prop. V. *Suppoſe I want but one Game, and my Fellow-Gameſter three, it is required to make a juſt Diſtribution of the Stake.*

LET us here likewiſe conſider in what ſtate we ſhould be, if I or he gain'd the firſt Game; if I gain, I have the Stake a, if he, then he wants yet 2 Games, and I but 1, and therefore we ſhould be in the ſame Condition which is ſuppoſed in the former Propoſition; and ſo there would fall to my Share, as was demonſtrated there, $\frac{3}{4}a$; therefore with equal facility there may happen to me a, or $\frac{3}{4}a$, which, by the firſt Propoſition, is worth $\frac{7}{8}a$, and to my Fellow-Gameſter there is left $\frac{1}{8}a$, and therefore my hazard to his is as 7 to 1.

As the Calculation of the former Propoſition was requiſite for this, ſo this will ſerve for the following. If I ſhould ſuppoſe myſelf to want but one Game, and my Fellow four, (by the ſame Method) you will find $\frac{15}{16}$ of the Stake belongs to me, and $\frac{1}{16}$ to him.

Prop. VI. *Suppoſe I want two Games, and my Fellow Gameſter three.*

THEN by the next Game it will happen that I want but one, and he three, which (by the preceeding Propoſition) is worth $\frac{7}{8}a$; or that we ſhould both want two, whence there will be $\frac{1}{2}a$ due to each of us: Now I being in an equal probability to gain or loſe the next Game, I have an equal hazard to gain $\frac{7}{8}a$ or $\frac{1}{2}a$, which by the firſt Propoſition is worth $\frac{11}{16}a$; and ſo there are eleven parts of the Stakes due to me, and five to my Fellow.

PROP. VII. *Let us ſuppoſe I want two Games, and my Fellow four.*

IF I gain the next Game, then I ſhall want but one, and my Fellow four; but if I loſe it, then I ſhall want two, and he three: So I have an equal hazard for gaining $\frac{11}{16}a$, or $\frac{11}{16}a$, which, by the firſt is worth $\frac{11}{16}a$: So it appears, that he who is to gain two Games for the other's four, is in a better Condition than he who is to gain one for the other's two; for my ſhare in the firſt caſe is $\frac{3}{4}a$ or $\frac{11}{16}a$, which is leſs than $\frac{1}{16}$, my ſhare in the laſt.

PROP. VIII. *Let us ſupppoſe three Gameſters, whereof the firſt an ſecond want* 1 *Game, but the third* 2.

TO find the ſhare of the firſt, we muſt conſider what would happen if either he, or any of the other two gain'd the firſt Game; if he gains, then he has the Stake a; if the ſecond gain, he has nothing; but if the third gain, then each of them would want a Game, and ſo $\frac{1}{3}a$ would be due to every one of them. Thus the firſt Gameſter has one Expectation to gain a, one to gain nothing, and one for $\frac{1}{3}a$, (ſince all are in equal probability to gain the firſt Game) which by the ſecond Propoſition is worth $\frac{4}{9}a$: Now ſince the ſecond Gameſter's Condition is as good, his Share is likewiſe $\frac{4}{9}a$, and ſo there remains to the third $\frac{1}{9}a$, whoſe Share might have been as eaſily found by itſelf.

PROP. IX. *In any number of Gameſters you pleaſe, amongſt whom there are ſome fewer Games: To find what is any one's ſhare in the Stake, we muſt conſider what would be due to him, whoſe Share we inveſtigate, if either he, or any of his Fellow-Gameſters ſhould gain the next following Game; add all their*

their Shares together, and divide the Sum by the number of the Gameſters, the Quotient is his Share you were ſeeking.

SUppoſe three Gameſters *A*, *B*, and *C*; *A* wants 1 Game, *B* 2, and *C* likewiſe 2, I would find what is the ſhare of the Stake due to *B*, which I ſhall call *q*.

Firſt, we muſt conſider what would fall to *B*'s Share, if either he, *A*, or *C*, wins the next Game; if *A* wins, the Game is ended, ſo he gets nothing; if *B* himſelf gain, then he wants 1 Game, *A* 1, and *C* 2; therefore, by the former Propoſition, there is due to him in that Caſe $\frac{4}{9}q$, then if *C* gains the next Play, then *A* and *C* would want but 1, and *B* 2; and therefore, by the eighth Propoſition, his Share would be worth $\frac{1}{3}q$; add together what is due to *B* in all theſe three Caſes, *viz.* $0\frac{4}{9}q$, the Sum is $\frac{7}{9}q$, which being divided by 3, the number of Gameſters, gives $\frac{7}{27}q$, which is the Share of *B* ſought for: The Demonſtration of this is clear from the ſecond Propoſition, becauſe *B* has an equal hazard to gain $0\frac{4}{9}q$ or $\frac{1}{9}q$, that is $\frac{0+\frac{4}{9}q+\frac{1}{9}q}{3}$, *i. e.* $\frac{5}{27}q$: Now it's evident the Diviſor 3 is the number of the Gameſters.

To find what is due to one in any Caſe; *viz.* if either he, or any of his Fellow Gameſters win the following Game; we muſt conſider firſt the more ſimple Caſes, and by their help the following; for as this Caſe could not be ſolved before the Caſe of the eighth Propoſition was calculated, in which, the Games wanting were 1, 1, 2; ſo the Caſe, where the Games wanting are 1, 2, 3, cannot be calculated, without the Calculation of the Caſe, where the Games wanting are 1, 2, 2, (which we have juſt now perform'd) and likewiſe of the Caſe, where the Games

Games wanting are 1, 2, 2, (which we have juſt now perform'd) and likewiſe of the Caſe, where the Games wanting are 1, 1, 3, which can be done by the eighth: And by this means you may reckon all the Caſes comprehended in the following Tables, and an infinite number of others.

Games wanting	1,1,2	1,2,2	1, 1,3	1,2,3
Their Shares	4,4,1	17,5,5	13,13,1	19,6,2
	9	27	27	27

Games want.	1, 1,4	1, 1,5	1, 2,4	1, 2,5
Shares	40,40,1	121,121,1	178,58,7	542,179,8
	81	243	243	729

Games wanting	1,3,3	1, 3, 4	1, 3, 5
Their Shares	65,8,8	616,82,31	629,87,13
	81	729	729

Games want.	2, 2, 3	2, 2, 4	2, 2, 5
Their Shares	34,34,13	338,338,53	353,353,23
	81	729	729

Games want.	2, 3, 3	2, 3, 4	2, 3, 5
Their Shares	133,55,55	451,195,83	433,635,119
	243	729	1187

As

As for the *Dice*; theſe Queſtions may be propoſed, at how many Throws one may wager to throw 6, any Number below that, with one Die; How many Throws are required for 12 upon two Dice; or 18 on 3; and ſeveral other Queſtions to this purpoſe.

For the reſolving of which, it muſt be conſider'd, that in one Die there are ſix different Throws, all equally probable to come up; for I ſuppoſe the Die has the exact figure of a Cube: On two Dice there are 36 different throws; for in reſpect to every throw of one Die, any one throw of the 6 of the other Die may come up; and 6 times 6 make 36. In three Dice there are 216 different throws; for in relation to any of the 36 throws of two Dice, any one of the ſix of the third may come up; and 6 times 36 make 216: So in four Dice there are 6 times 216 throws, that is, 1296: And ſo forward you may reckon the throws of any number of Dice, taking always, for the Addition of a new Die, 6 times the number of the preceding.

Beſides, it muſt be obſerved, that in two Dice there is only one way 2 or 12 can come up; two ways that 3 or 11 can come up; for if I ſhall call the Dice A and B, to make 3 there may be 1 in A, and 2 in B, or 2 in A, and 1 in B; ſo to make 11, there may be 5 in A, and 6 in B, or 6 in A, or 2 as well in A as B; for 10 there are likewiſe three Chances; for 5 or 9 there are four Chances; for 6 or 8 five Chances; for 7 there are ſix Chances.

In 3 Dice there are found for	3 or 18	1
	4 or 17	3
	5 or 16	6
	6 or 15	10
	7 or 14	15
	8 or 13	21
	9 or 12	25
	10 or 11	27

Prop. X. *To find at how many times one may undertake to throw* 6 *with one Die.*

IF any ſhould undertake to throw 6 the firſt time, it's evident there's one Chance gives him the Stake, and five which give him nothing; for there are 5 throws againſt him, and only one for him. Let the Stake be called a, then he has one Expectation to gain a, and five to gain nothing, which, by the third Propoſition, is worth $\frac{1}{6}a$, and there remains for the other $\frac{5}{6}a$; ſo he who undertakes, with one Die, to throw 6 the firſt time, ought to wager only 1 to 5.

2. Suppoſe one undertake, at two Throws of 1 Die, to throw 6, his Hazard is calculated thus; if he throw 6 at the firſt, he has a the Stake; if he do not, there remains to him one throw, which, by the former Caſe, is worth $\frac{5}{6}a$; but there is but one Chance which gives him 6 at the fiſt throw, and five Chances againſt him; ſo there is one Chance which gives him a, and five which give $\frac{5}{6}a$, which by the ſecond Propoſition, is worth $\frac{11}{36}a$, ſo there remains to his Fellow-Gameſter $\frac{25}{36}a$; ſo the Value of my Expectation to his, is as 11 to 25, *i. e.* leſs than 1 to 2.

By the ſame Method of Calculation, you will find, that his hazard who undertakes to throw 6 at three

three times with one Die, is $\frac{91}{216}a$; ſo that he can only lay 91 againſt 125, which is ſomething leſs than 3 to 4.

He who undertakes to do it at four times, his hazard is $\frac{671}{1296}a$, ſo he may wager 671 againſt 625, that is, ſomething more than 1 to 1.

He who undertakes to do it at five times, his hazard is $\frac{4651}{7776}a$, ſo he can wager 671 againſt 625, that is, ſomething leſs than 3 to 2.

His hazard who undertakes to do it at 6 times, is $\frac{31031}{46656}a$, and he can wager 4651 againſt 3125, that is, ſomething leſs than 2 to 1.

Thus any number of throws may be eaſily found; but the following Propoſition will ſhew you a more compendious way of Calculation.

Prop. XI. *To find at how many times one may undertake to throw* 12 *with two Dice.*

IF one ſhould undertake it at one throw, it's clear he has but one Chance to get the Stake *a*, and 35 to get nothing; which, by the third Propoſition, is worth $\frac{1}{36}a$.

He who undertakes to do it at twice, if he throw 12 the firſt time, gains *a*; if otherwiſe, then there remains to him one throw, which, by the former Caſe, is worth $\frac{1}{36}a$; but there is but one Chance which gives 12 at the firſt throw, and 35 Chances againſt him; ſo he has 1 Chance for *a*, and 35 for $\frac{1}{36}a$, which by the third Propoſition is worth $\frac{71}{1296}a$, and there remains to his Fellow-Gameſter $\frac{1225}{1296}a$.

From theſe it's eaſy to find the Value of his hazard, who undertakes it at four times, paſſing by his caſe who undertakes it at three times.

If he who undertakes to do it at four times throws 12 the firſt or ſecond Caſt, then he has *a*; if not, there remains two other throws, which, by the former

former Caſe, are worth $1\frac{71}{1296}a$; but for the ſame reaſon, in his two firſt throws, he has 71 Chances which give him a, againſt 1225 Chances, in which it may happen otherwiſe; therefore at firſt he has 71 Chances which give him a, and 1225 which give him $1\frac{71}{1296}a$, which by the third Propoſition is worth $\frac{178991}{1679616}a$, which ſhews that their hazards to one another are as 178991 to 1500625.

From which Caſes it is eaſy to find the Value of his Expectation, who undertakes to do it at 8 times, and from that, his Caſe who undertakes to do it at 16 times; and from his Caſe who undertakes to do it at 8 times, and his likewiſe who undertakes to do it at 16 times; it is eaſy to determine his Expectation who undertakes to do it at 24 times: In which Operation, becauſe that which is principally ſought, is the number of throws, which makes the hazard equal on both ſides, *viz.* to him who undertakes, and he who offers, you may, without any ſenſible Error, from the Numbers (which elſe would grow very great) cut off ſome of the laſt Figures. And ſo I find, that he who undertakes to throw 12 with two Dice, at 24 times, has ſome loſs; and he who undertakes it at 25 times, has ſome advantage.

Prop. XII. *To find how many Dice one can undertake to throw two Sixes at the firſt Caſt.*

THIS is as much, as if one would know, at how many throws of one Die, he may undertake to throw twice ſix: now if any ſhould undertake it at two throws, by what we have ſhewn before, his hazard would be $\frac{1}{36}a$; he who would undertake to do it at 3 times, if his firſt throw were not 6, then there would remain two throws, each of which muſt be 6, which (as we have ſaid) is worth $\frac{1}{36}a$; but if the firſt throw be 6, he wants only

only one 6 in the two following throws, which by the tenth Propoſition, is worth $\frac{11}{36}a$: but ſince he has but one Chance to get 6 the firſt throw, and five to miſs it; he has therefore, at firſt, one Chance for $\frac{11}{36}a$, and five Chances for $\frac{1}{36}a$, which, by the third Propoſition, ie worth $\frac{16}{216}a$, or $\frac{2}{27}a$; after this manner ſtill aſſuming 1 Chance more, you will find that you may undertake to throw two Sixes at 10 throws of one Die, or 1 throw of ten Dice, and that with ſome advantage.

Prop. XIII. *If I am to play with another one Throw, on this condition, that if 7 comes up I gain, if 10 he gains; if it happens that we muſt divide the Stake, and not play, to find how much belongs to me, and how much to him.*

BEcauſe of the 36 different Throws of the two Dice, there are ſix which give 7 and 3 which give 10, and 27 which equals the Game, in which caſe there is due to each of us $\frac{1}{2}a$: But if none of the 27 ſhould happen, I have 6, by which I may gain a, and 3, by which I may get nothing, which by the third Propoſition, is worth $\frac{2}{3}a$; ſo I have 27 Chances for $\frac{1}{3}a$, and 9 for $\frac{2}{3}a$, which by the third Propoſition, is worth $\frac{15}{24}a$, and there remains to my Fellow-Gameſter $\frac{11}{24}a$.

Prop. XIV. *If I were playing with another by turns, with two Dice, on this Condition, that if I throw 7 I gain, and if he throw 6 he gains allowing him the firſt Throw: To find the proportion of my Hazard to his.*

SUppoſe I call the Value of my Hazard x, and the Stakes a, then his Hazard will be $a---x$; then whenever it's his turn to throw, myHazard is x, but

but when it's mine, the Value of my Hazard is greater. Suppoſe I then call it y; now becauſe of the 36 throws of two Dice, there are five which give my Fellow-Gameſter 6, thirty-one which bring it again to my turn to throw, I have five Chances for nothing, and thirty-one for y, which, by the third Propoſition, is worth $\frac{31}{36}y$; but I ſuppos'd at firſt my Hazard to be x; therefore $\frac{31}{36}=x$, and conſequently $y=\frac{36}{31}x$. I ſuppos'd likewiſe, when it was my turn to throw, the Value of my Hazard was y; but then I have ſix Chances, which give me 7, and conſequently the Stake, and thirty which give my Fellow the Dice, that is make my Hazard worth x: ſo I have ſix Chances for a, and thirty for x, which, by Prop. 3. is worth $\frac{6a+30x}{36}$, but this by ſuppoſition is equal to y, which is equal (by what has been prov'd already) to $\frac{36}{31}x$; therefore $\frac{30x+6a}{36}=\frac{36}{31}x$, and conſequently $x=\frac{31}{61}a$, the Value of my Hazard, and that of my Fellow-Gameſter is $\frac{30}{61}a$, ſo that mine is to his as 31 to 30.

Here follow ſome Queſtions which ſerve to exerciſe the former Rules.

1. *A* and *B* play together with two Dice, *A* wins if he throws 6, and *B* if he throws 7; *A* at firſt gets one throw, then *B* two, then *A* two, and ſo on by turns, till one of them wins. I require the proportion of *A*'s Hazard to *B*'s? *Anſwer*, It is as 10355 to 12276.

2. Three Gameſters, *A*, *B*, and *C*, take 12 Counters, of which there are four white and eight black;

black; the Law of the Game is this, that he ſhall win, who, hood-wink'd, ſhall firſt chuſe a white Counter; and that *A* ſhall have the firſt choice, *B* the ſecond, and *C* the third, and ſo, by turns, till one of them win. *Quær.* What is the proportion of their Hazards?

3. *A* wagers with *B*, that of 40 Cards, that is, 10 of every Suit, he will pick out four, ſo that there ſhall be one of every ſuit. *A*'s Hazard to *B*'s in this caſe is as 1000 to 8139.

4. Suppoſing, as before, 4 white Counters and 8 black, *A* wagers with *B*, that out of them he ſhall pick 7 Counters, of which there are 3 white. I require the proportion of *A*'s Hazard to *B*'s?

5. *A* and *B* taking 12 Counters, each play with three Dice after this manner, that if 11 comes up, *A* ſhall give one Counter to *B*; but if 14 comes up, *B* ſhall give one to *A*, and that he ſhall gain who firſt has all the Counters. *A*'s Hazard to *B*'s is 244140625 to 282429536481.

The *Calculus* of the preceding Problems is left out by Monſ. *Huygens*, on purpoſe that the ingenious Reader may have the ſatisfaction of applying the former Method himſelf; it is in moſt of them more laborious than difficult: For *Example*, I have pitch'd upon the ſecond and third, becauſe the reſt can be ſolv'd after the ſame Method.

Problem 1.

The firſt Problem is ſolv'd by the Method of Prop. 14. only with this difference, that after you have found the Share due to *B*, if *A* were to get no

firſt throw, you muſt ſubtract from it $\frac{5}{36}$ of the Stake which is due to *A* for his Hazard of throwing ſix at the firſt throw.

Problem 2.

As for the ſecond Problem, it is ſolv'd thus; Suppoſe *A*'s Hazard, when it is his own turn to chuſe, be x, when it is *B*'s, be y, and when it is *C*'s, be z; it is evident, when out of 12 Counters, of which there are 4 white and 8 black, he endeavours to chuſe a white one, he has four Chances to get it, and eight to miſs it; that is, he has four Chances to get the Stake a, and eight to make his hazard worth y: ſo $x = \frac{4a+8y}{12}$, and conſequently $y = \frac{12x-4a}{8}$. When it is *B*'s turn to chuſe, then he has four Chances for nothing, and eight for z, (that is, to bring it to *C*'s turn) conſequently $y = \frac{8}{12}z = \frac{12x-4a}{8}$; this Equation reduc'd gives $z = \frac{9x-3a}{4}$; when it comes to *C*'s turn to chuſe, then *A* has four Chances for nothing, and eight for x, conſequently $z = \frac{8}{12}x$, therefore $\frac{8}{12}x = \frac{9x-3a}{4}$ this equation reduc'd gives $x = \frac{9}{15}a$, and conſequently there remains to *B* and *C* $\frac{10}{15}a$, which muſt be ſhar'd after the ſame manner, that is, ſo that *B* have the firſt Choice, *C* the next, and ſo on, till one of them gain; the Reaſon is, becauſe it had been juſt in *A* to have demanded $\frac{9}{15}$ of the Stake for not playing, and then the Seniority fell to *B*; now $\frac{10}{15}a$, parted betwixt *B* and *C*, by the former Method, gives $\frac{6}{15}$ to *B*, and $\frac{4}{15}$ to *C*; ſo *A*, *B*, and *C*'s Hazard's from the beginning were as 9, 6, 4.

I have ſuppos'd here the Senſe of the Problem to be, that when any one chus'd a Counter, he did not diminiſh their number; but if he miſs'd of a white one, put it in again, and left an equal hazaad to him who had the following choice; for if it be otherwiſe ſuppos'd, *A*'s ſhare will be $\frac{11}{121}$, which is leſs than $\frac{9}{15}$.

Prob. 2. It is evident, that wagering to pick out 4 Cards out of 40, ſo that there be one of every Suit, is no more than wagering, out of 39 Cards to take three propoſed Suits; for it is all one which Card you draw firſt, all the hazard being whether out of the 39 remaining you take 3, of which none ſhall be of the Suit you firſt drew: Suppoſe then you had gone right for three times, and were to draw your laſt Card, it is clear that there are 27 Cards, (*viz.* of the Suits you have drawn before) of which, if you draw any you loſe, and 10, of which if you draw any, you have the Stake *a*; ſo you have 10 Chances for *a*, and 27 for nothing, which by Prop. 3. is worth $\frac{10}{37}a$. Suppoſe again you had gone right only for two Draughts, then you have 18 Cards (of the Suits yon have drawn before) which make you loſe, and 20, which put you in the Caſe ſuppoſed formerly, *viz.* where you have but one Card to draw which, as we have already calculated, is worth $\frac{10}{37}a$; ſo you have 18 Chances for nothing, and 20 for $\frac{10}{37}a$, which, by Prop. 3. is worth $\frac{100}{703}a$. Suppoſe again you have 3 Cards to draw, then you have 9 (of the Suit you drew firſt) which make you loſe, and 30 which put you in the caſe ſuppos'd laſt; ſo you have 9 Chances for nothing, and 30 for $\frac{100}{703}a$, which by Propoſ. 3. is worth $\frac{3000}{26717}a$, or $\frac{1000}{9139}a$, and you leave to your Fellow-Gameſter $\frac{8139}{9139}a$; ſo your Hazard is to his as 1000 to 8139.

It is eaſy to apply this Method to the Games that are in uſe amongſt us: for *Example*, If *A* and *B*, playing at *Back-gammon*, *A* had already gain'd one end of three, and *B* none, and if *A* had the Dice in his Hand for the laſt throw of the ſecond end all, his Men but two upon the Ace Point being already caſt off: *Quær.* What is the proportion of *A*'s Hazard to *B*'s?

Solution: There being of the 36 Throws of two Dice, ſix which give Doublets; if *A* throw any of the ſix, he has the ſtake *a*; if he throw any of the other thirty, then he wants but one Game, and his Fellow-Gameſter three, which by Prop. V. is $\frac{7}{8}a$; ſo *A* has ſix Chances for *a*, and thirty for $\frac{7}{8}a$, which, by Prop. III. is worth $\frac{129}{144}a$, and there remains to his Play-Fellow $\frac{15}{144}a$; ſo *A*'s Hazard to *B*'s is as 129 to 15, that is, leſs than 9 to 1.

Suppoſing the ſame Caſe, and if their Bargain had been, that he gain'd three ends before the other gain'd one, ſhould have double of what each ſtak'd, that is, the Stake and a half more, then there had been due to *A* $\frac{252}{288}$ of the Stake, that is, *B* ought only to take $\frac{1}{48}$, and leave the reſt to *A*.

Thus likewiſe, if you apply the former Rule to the *Royal-Oak Lottery*, you will find, that he who wagers that any Figure ſhall come up at the firſt throw, ought to wager 1 againſt 31; that he who wagers it ſhall come up at one of the two throws, ought to wager 63 againſt 961; that he who wagers that a Figure ſhall come up at once in three times, ought to lay 125055 againſt 923521, *&c.* it being only ſomewhat tedious to calculate the reſt. Where you will find, that the equality will not find, that the equality will not fall as ſome imagine on 16 Throws, no more than the equality of wagering at how many Throws of one Die 6 ſhall come up,

falls

falls on three; the contrary of which you have ſeen already demonſtrated: You will find by calculation, that he has the Diſadvantage, who wagers, that 1 of the 32 different Throws of the *Royal-Oak Lottery* ſhall come at once of 20 times, and that he has ſome advantage, who wagers on 22 times, ſo the neareſt to Equality is on 21 times. But it muſt be remembred, that I have ſuppos'd in the former Calculation, the Ball in the *Royal-Oak Lottery*, to be regular, tho' it can never be exactly ſo; for he, who has the ſmalleſt Skill in Geometry, knows that there can be no regular Body of 32 ſides; and yet this can be of no Advantage to him who keeps it.

To find the Value of the Throws of Dice, as to the Quantity.

NOthing is more eaſy, than by the former Method to determine the Value of any number of Throws of any number of Dice; for in one throw of a Die, I have an equal Chance for 1, 2, 3, 4, 5, 6, conſequently my Hazard is worth their Sum 21 divided by their Number 6, that is, $3\frac{1}{2}$. Now if one throw of a Die be worth $3\frac{1}{2}$, then two throws of a Die, or one throw of two Dice is worth 7, two throws of two Dice, or one throw of four Dice is worth 14, *&c.* The general Rule being to multiply the Number of Dice, the Number of Throws, and $3\frac{1}{2}$ continually.

This is not to be underſtood as if it were an equal Wager to throw 7, or above it, with two Dice at one throw; for he who undertakes to do ſo, has the Advantage by 21 againſt 15. The meaning is only, if I were to have a Guinea, a Shilling, or anything elſe, for every Point that I threw with two Dice at one throw, my Hazard is worth 7 of theſe, becauſe he who gave me 7 for it, would have an equal pro-

bability of gaining or losing by it, the Chances of the Throws above 7, being as many as of these below it: So it is more than an equal Wager to throw 12 at least at two Throws of two Dice, because it is more probable that 14 will come, than any one Number besides, and as probable that it will be above it as below it; but if one were to buy this Hazard at the rate abovemention'd, he ought just to give 14 for it. The equal wager in one Throw of two Dice, is to throw 7 at least one time, and 8 at least another time, and so *per vices*: The Reason is, because in the first Case I have 21 Chances against 15, and in the second 15 Chances against 21.

Of Raffling.

IN *Raffling*, the different Throws and their Chances are these; Where it is to be observed, that of the 216 different Throws of three Dice, there are only 96 that give Doublets, or two, at least, of a kind; so it is 4 to 5 that with three Dice you shall throw Doublets, and it is 1 to 35 that you throw a Raffle, or all three of a Kind. It is evident likewise, that it is an even Wager to throw 11 or above it, because there are as many Chances for 11, and the Throws above it, as for the Throws below it; but tho' it be an even Wager to throw 11 at one Throw, it is a Disadvantage to wager to throw 22 at two Throws, and far more to wager to throw 33 at three Throws; and yet it is more than an equal Wager that you shall throw 21 at two Throws in Raffling, because it is as probable that you will, as that you will not throw 11, at least, the first time, and more than probable that you will throw 10, at least the second Time.

Throws.		Chan.
3	18	1
4	17	3
5	16	6
6	15	4
7	14	9
8	13	9
9	12	7
10	11	9

For

For an inſtance of the plainneſs of the preceding Method, I will ſhew, how by ſimple Subſtraction, the moſt part of the former Problems my be ſolv'd.

Suppoſe *A* and *B*, playing together, each, of them ſtakes 32 Shillings, and that *A* wants one Game of the number agreed on, and *B* wants two; to find the ſhare of the Stakes due to each of them. It's plain, if *A* wins the next Game, he has the whole 64 Shillings; if *B* wins it, then their Shares are equal; therefore ſays *A* to *B*, If you will break off the Game, give me 32, which I am ſure of, whether I win or loſe the next Game; and ſince you will not venture for the other 32, let us part them equally, that is, give me 16, which with the former 32 make 48, leaving 16 to you.

Suppoſe *A* wanted one Game, and *B* three; if *A* wins the next Game, he has the 64 Shillings; if *B* wins it, then they are in the condition formerly ſuppos'd, in which caſe there is 48 due to *A*; therefore ſays *A* to *B*, give me the 48 which I am ſure of, whether I win or loſe the next Game; and ſince you will not hazard for the other 16, let us part them equally, that is, give me 8, which, with the former 48, make 56, leaving 8 to you; and ſo all the other Caſes may be ſolv'd after the ſame manner.

Suppoſe *A* wagers with *B*, that with one Die he ſhall throw 6 at one of three Throws, and that each of them ſtakes 108 Guineas; to find what is the proportion of their Hazards. Now there being in one Throw of a Die but one Chance for 6, and five Chances againſt it, one Throw for 6 is worth $\frac{1}{6}$ of the Stake; therefore ſays *B* to *A*, of the 216 Guineas take a ſixth part for your firſt Throw, that is, 36; for your next Throw take a ſixth part of the remaining 180, that is, 30; and for your third Throw, take a ſixth part of the remaining 150, that is, 25,

which in all make 91, leaving to me 125; ſo his hazard who undertakes to throw 6 at one of the three Trows, is 91 to 125.

Suppoſe *A* had undertaken to throw 6 with one Die at one Throw of four, and that the whole Stake is 1296; ſays *A* to *B*, every Throw for 6 of one Die, is worth the ſixth part of what I throw for; therefore for my firſt Throw give me 216, which is the ſixth part of 1296, and there remains 1080, I muſt have the ſixth part of that, *viz.* 180, for my ſecond Throw; and the ſixth part of the remaining 900, which is 150, for my third Throw; and the ſixth part of the laſt remainder 750, which is 125 for my fourth; all this added together makes 671, and there remains to you 625; ſo it is evident, that *A*'s Hazard, in this Caſe, is to *B*'s 671 to 525.

Suppoſe *A* is to win the Stakes (which we ſhall ſuppoſe to be 36 (if he throws 7 at once of twice with two Dice, and *B* is to have them if he does not; ſays *B* to *A*, the Chances which give 7 are 6 of the 36, which is as much as 1 of 6; therefore for your firſt Throw you ſhall have a ſixth part of the 36, which is 6; and for your next Throw a ſixth part of the remainder 30, which is 5; this in all makes 11; ſo you leave 25 to me; ſo *A*'s Hazard is to *B*'s as 11 to 25.

It were eaſy, at this rate, to calculate the moſt intricate Hazards, were it not that Fractions will occur; which, if they be more than $\frac{1}{2}$, may be ſuppos'd equal to an Unit, without cauſing any remarkable Error in great Numbers.

It will not be amiſs, before I conclude, to give you a Rule for finding in any number of Games the Value of the firſt, becauſe *Huygens*'s Method, in that Caſe, is ſomething tedious.

Suppoſe

Suppoſe *A* and *B* had agreed, that he ſhould have the Stakes who did win the firſt 9 Games, and *A* had already won one of the 9; I would know what ſhare of *B*'s Money is due to *A* for the Advantage of this Game. To find this, take the firſt eight even Numbers 2, 4. 6, 8, 10, 12 14, 16, and multiply them continually, that is, the firſt by the ſecond, the product by the third, *&c.* take the firſt eight odd Numbers 1, 3, 5, 7, 9, 11, 13, 15, and do juſt ſo by them, the product of the even Number is the Denominator, and the product of the odd Number the Numerator of a Fraction, which expreſſeth the quantity of *B*'s Money due to *A* upon the winning of the firſt Game of 9; that is, if each ſtak'd a number of Guineas, or Shillings, *&c.* expreſs'd by the Product of the even Numbers, there would belong to *A*, of *B*'s Money, the Number expreſs'd by the product of the odd Numbers. For *Example*, Suppoſe *A* had gain'd one Game of 4, then by this Rule, I take the three firſt even Numbers, 2, 4, 6, and multiply them continually, which make 48, and the firſt three odd Numbers, 1, 3, 5, and multiply them continually, which make 15; ſo there belongs to $A\frac{15}{48}$ of *B*'s Money, that is, if each ſtak'd 48, there would belong to *A*, beſides his own, 15 of *B*'s. Now by *Huygens*'s Method, if *A* wants but three Games while *B* wants four, there is due to $A\frac{21}{32}$ of the Stake; by this Rule there is due to $A\frac{15}{48}$ of *B*'s Money, which is $\frac{15}{63}$ of the Stake, which, with his own $\frac{48}{96}$ of the Stake, makes $\frac{62}{96}$ or $\frac{21}{32}$ of the Stake; and ſo in every Caſe you will find *Huygens*'s Method, and this will give you the ſame Number: A Demonſtration of it you may ſee in a Letter of Monſieur *Paſcal*'s to Monſieur *Fermat*; though it be otherwiſe expreſs'd there than here, yet the conſequence is eaſily ſupply'd. To

prevent

prevent the labour of Calculation, I have ſubjoin'd the following Tbale, which is calculated for two Gamſters, as Monſieur *Huygens*'s is for three.

If each of us ſtake 256 *Guineas* in

There belongs to me 256 of my Play-fellow

	6	5	4	3	2	1
1 ſt *Game*	63	70	80	96	128	256
2 1 ſt *Games*	126	140	160	192	256	
3 1 ſt *Games*	182	200	224	256		
4 1 ſt *Games*	224	240	256			
5 1 ſt *Games*	248	256				
6 1 ſt *Games*	256					

The Uſe of the Table is plain; for let our Stakes be what they will, I can find the Portion due to me upon the winning the firſt, or the firſt two Games, *&c.* of 2, 3, 4, 5, 6. For *Example*, If each of us had ſtak'd 4 Guineas, and the number of Games to be play'd were 3, of which I had gain'd 1, I ſay, As 256 is to 96, ſo is 4 to a fourth.

256 :

256 : 96 :: 4 : $1\frac{1}{2}$.

To find what is the Value of his Hazard, who undertakes, at the firſt Throw, to caſt Doublets, in any given number of Dice.

In two Dice it is plain, to avoid Doublets, every one of the ſix different Throws of the firſt, can only be combin'd with five of the ſecond, becauſe one of the ſix is of the ſame kind, and conſequently makes Doublets; for the ſame Reaſon, the thirty Throws of two Dice, which are not Doublets, can only be combin'd with four Throws of a Dice ſo generally it is this Series,

$$\frac{6\times5\times4\times3\times2\times1\times0,\ \&c.}{6\times6\times6\times6\times6\times6\times6,\ \&c.}$$

The ſecond Series is the Sum of the Chances, and the firſt the Number of Chances againſt him who undertakes to throw Doublets, each Series to be continu'd ſo many terms, as are the Number of Dice. For *Example*, If one ſhould undertake to throw Doublets at the firſt Throw of four Dice, his Adverſary's Hazard is $\frac{6\times5\times4\times3}{6\times6\times6\times} = \frac{360}{1296}$ or $\frac{5}{18}$ leaving to him $\frac{13}{18}$, ſo he has 13 to 5. In ſeven Dice, you ſee the Chances againſt him are 0, becauſe then there muſt neceſſarily be Doublets.

Of Whist.

If there be four playing at Whiſt, *it is* 15 *to* 1 *that any two of them ſhall not have the four Honours, which I demonſtrate thus.*

SUppoſe the four Gameſter's be *A*, *B*, *C*, *D*: If *A* and *B* had, while the Cards are a dealing already

ready got three Honours, and wanted only one, ſince it is as probable that *G* and *D* will have the next Honour, as *A* and *B*; if *A* and *B* had laid a Wager to have it, there is due to them but $\frac{1}{2}$ of the Stake: If *A* and *B* wanted two of the four, and had wager'd to have both thoſe two, then they have an equal hazard to get nothing, if they miſs the firſt of theſe two, or to put themſelves in the former Caſe if they get; ſo they have an equal Hazard to get nothing, or $\frac{1}{4}$, which by *Prop.* 1. is worth $\frac{1}{4}$ of the Stake; ſo if they want three Honours, you will find due to them $\frac{1}{8}$ of the Stake; and if they wanted four, $\frac{1}{16}$ of the Stake leaving *C* and *D* $\frac{15}{16}$; ſo *C* and *D* can wager 15 to 1, that *A* and *B* ſhall not have all the four Honours.

It is 11 *to* 5 *that* A *and* B *ſhall not have three of the four Honours, which I prove thus:*

It is an even Wager, if there were but three Honours, that *A* and *B* ſhall have two of theſe three, ſince 'tis as probable that they will have two of the three, as that *C* and *D* ſhall have them; conſequently, if *A* and *B* had laid a Wager to have two of three, there is due to them $\frac{1}{2}$ of the Stake. Now ſuppoſe *A* and *B* had wager'd to have three of four, they have an equal hazard to get the firſt of the four, or miſs it; if they get it, then they want two of the three, and conſequently there is due to them $\frac{1}{2}$ of the Stake; if they miſs it, then they want three of the three, and conſequently there is due to them $\frac{1}{8}$ of the Stake; therefore, by *Prop.* 1. their Hazard is worth $\frac{5}{16}$, leaving to *C* and *D* $\frac{11}{16}$.

A *and* B *playing at* Whist *againſt* C *and* D; A *and* B *have eight of ten, and* C *and* D *nine, and therefore can't reckon Honours; to find the proportion of their Hazards.*

There is $\frac{5}{16}$ due to *A* and *B* upon their hazard of having three of four Honours, but ſince *C* and *D* want but one Game, and *A* and *B* two, there is due to *A* and *B* but $\frac{1}{4}$, or $\frac{4}{16}$ more upon that Account, by *Prop.* 4. this in all makes $\frac{9}{16}$, leaving to *C*, and *D* $\frac{7}{16}$; ſo the hazard of *A* and *B* to that of *C* and *D*, is as 9 to 7.

In the the former Calculations I have abſtracted from the ſmall difference of having the Deal and being Seniors.

All the former Caſes can be calculated by the *Theorems* laid down by Monſieur *Huygens*; but Caſes more compos'd require other Principles: For the eaſy and ready Computation of which, I ſhall add one *Theorem* more, demonſtrated after Monſieur *Huygens*'s Method.

THEOREM.

If I have p Chances for a, q Chances for b, and r Chances for c, then my hazard is worth $\frac{ap+bq+cr}{p+q+r}$; that is, a multiplied into the number of its Chances, added to b, multiplied into the number of its Chances, added to c, multiplied into the number of its Chances, and the Sum divided by the Sum of of Chances of a, b, c.

To inveſtigate as well as demonſtrate this *Theorem*, ſuppoſe the value of my hazard be x, then x muſt be ſuch, as having it, I am able to purchaſe as good a Hazard again in a juſt and equal Game. Suppoſe the Law of it be this, That playing with ſo many Gameſters as, with myſelf, make up the number $p+q+r$, with as many of them as the number p repreſents,

preſents, I make this bargain, that whoever of them wins ſhall give me a, and that I ſhall do ſo to them if I win; with the Gameſters repreſented by the number of q, I bargain to get b, if any of them win, and to give b to each of them, if I win myſelf; and with the reſt of the Gameſters, whoſe number is $r-1$, I bargain to give, or to get c after the ſame manner: Now all being in an equal probability to gain, I have p Chances to get a, q Chances to get b, and $r-1$ Chances to get c, and one Chance, *viz.* when I win myſelf, to get $px+qx+rx-ap-bq-rc+c$, which if it be ſuppos'd equal to c, then I have p Chances for a, q Chances for b, and r Chances for c (for I had juſt now $r-1$ Chances for it) and therefore, in Caſe $px+qx+rx-ap-bq-rc+c=c$, then is $x=\frac{ap+bq+cr}{p+q+r}$.

By the ſame Way of reaſoning you will find, if I have p Chances for a, q Chances for b, r Chances for c, and s Chances for d, and that my Hazard is $\frac{ap+bq+cr+ds}{p+q+r+s}$, &c.

In Numbers.

If I had two Chances for 3 Shillings, four Chances for 5 Shillings, and one Chance for 9 Shillings, then, by this Rule, my Hazard is worth 5 Shillings; for $\frac{2\times3+4\times5+1\times9}{7}=5$; and it is eaſy to prove, that with 5 Shillings I can purchaſe a like Hazard again; for ſuppoſe I play with ſix others, each of us ſtaking 5 Shillings; with two of them I bargain, that if either of them win, he muſt give me 3 Shillings, and that I ſhall do ſo to them; and with the other four I bargain juſt ſo, to give or to get 5 Shillings: This is a juſt Game, and all being

ing in an equal probability to win; by this means I have two Chances to get 3 Shillings, four Chances to get 5 Shillings, and one Chance to get 9 Shillings, *viz.* when I win myſelf; for then out of the Stake, which makes 35 Shillings, I muſt give the firſt two 6 Shillings, and the other four 20 Shillings, ſo there remains juſt 9 to myſelf.

It is eaſy, by the Help of this *Theorem*, to calculate in the *Game of Dice*, commonly call'd *Hazard*, what Mains are beſt to ſet on, and who has the Advantage, the Caſter or Setter. The *Scheme* of the Game, as I take it, is thus:

	Throws next following for	
Mains.	The *Caſter.*	The *Setter.*
V.	V.	II. III. XI. XII.
VI.	VI. XII.	XI. II. III.
VII.	VII. XI.	XII. II. III.
VIII.	VIII. XII.	XI. II. III.
IX.	IX.	II. III. XI. XII.

By an eaſy Calculation you will find, if the Caſter has IV, and the Setter VII, there is due to the Caſter $\frac{1}{3}$ of the Stake; if he has

V againſt VII, $\frac{2}{3}$ of the Stake.
VI againſt VII, $\frac{5}{11}$ of the Stake.
IV againſt VI, $\frac{1}{8}$ of the Stake.
V againſt VI, $\frac{4}{5}$ of the Stake.
IV againſt V, $\frac{1}{7}$ of the Stake.

I need not tell the Reader, that IV is the ſame with X, V with IX, and VI with VIII.

Suppoſe then VII be the Main: To find the Proportion of the Hazard of the Caſter to that of the Setter.

By

By the Law of the Game, the Caſter, before he throws next, has four Chances for nothing, *viz.* theſe II, III, XII; eight Chances for the whole Stake, *viz.* thoſe of VII, XI; ſix Chances for $\frac{1}{3}$, *viz.* thoſe of IV, X; eight Chances for $\frac{2}{3}$, *viz.* thoſe of V, IX; and ten Chances for $\frac{5}{11}$, *viz.* thoſe of VI, VIII; ſo his Hazard, by the preceding *Theorem*, is

$$\frac{4 \times 0 + 8 \times 1 + 6 \times \frac{1}{3} + 8 \times \frac{2}{3} + 10 \times \frac{5}{11}}{36}$$

Now to ſave the Trouble of a tedious Reduction, ſuppoſe the Stake which they play for be 36, that is, the Setter had laid down 18; in that Caſe, every one of theſe Fractions are ſo many Parts of an Unit, which being gather'd into one Sum, give $17\frac{41}{55}$ to the Caſter, leaving $18\frac{14}{55}$ to the Setter; ſo the Hazard of the Caſter is to that of the Setter 244,251.

Suppoſe VI, or VIII, be the Main, then the Share of the Caſter is

II.
III. VI. IV. V.
XI. XII. X. IX. VIII. VII.

$$5 \times 0 + 6 \times 1 + \times 6\tfrac{3}{8} + 8 \times \tfrac{4}{9} + 5 \times \tfrac{1}{2} + 6 \times \tfrac{6}{11} = 17\tfrac{229}{396},$$

leaving to the Setter $18\frac{167}{396}$; ſo the Hazard of the Caſter is to that of the Setter as 6961 to 7295.

Suppoſe V, or IX, be the Main, then the Share of the Caſter is

II.

II.
III.
XI. IV. VI.
XII. V. X. IX. VIII. VII.

$6 \times 0 + 4 \times 1\bar{} + 6 \times \frac{3}{7} + 4 \times \frac{1}{2} + 10 \times \frac{5}{9} + 6 \times \frac{3}{5} = 17\frac{221}{315}$,

leaving to the Setter $\frac{86}{315}$; ſo the Hazard of the Caſter is to that of the Setter as 1396 to 1439.

It is plain, that in every Caſe the Caſter has the Diſadvantage, and that V, or IX, are better Mains to ſet on that VII, becauſe, in this laſt Caſt, the Setter has but 18 and $\frac{14}{35}$, or $\frac{84}{315}$; whereas, when V or IX is the Main, he has $18\frac{86}{315}$; likewiſe VI, or VIII, are better Mains than V, or IX, becauſe $\frac{167}{396}$ is a greater Fraction than $\frac{86}{315}$.

All thoſe Problems ſuppoſe Chances, which are in an equal Probability to happen; if it ſhould be ſuppoſed otherwiſe, there will ariſe Variety of Caſes of a quite different Nature, which, perhaps, it were not unpleaſant to conſider: I ſhall add one *Problem* of that Kind, leaving the Solution to thoſe who think it merits their Pains.

In Parallelipipedo cujus latera ſunt ad invicem in ratione a, b, c: *Invenire quotâ vice quivis ſuſcipere poteſt, ut datum quodvis planum, v. g.* a b *jaciat.*

THE LONGITUDE EXAMIN'D.

A Short Epiſtle to the *Longitudinarians.*

Gentlemen,

THE Books that are written about the Longitude, are ſo acceptable to the Publick, that the whole Edition is commonly ſold off, before any of them can reach our Northern *Bookſellers; therefore I hope you will not refuſe to admit me into your Number, tho' my Attempt is publiſh'd ſo late; neither will you look upon me as your Enemy, if I overthrow all your Schemes, to ſet up mine; for, if you'll believe me, I am in perfect Charity with you all: But Cuſtom will prevail, and then I muſt ſhew what I can do in the Beginning of my Book, that my Readers may enter upon the Deſcription of my Engine with a good Opinion of my Skill; tho' the main Reaſon is, that, without Animadverſions upon the Attempts of others, I could not ſwell this to a Six-penny Book, unleſs I had embelliſh'd the Recommendation of my Device with fine Metaphors, and clever Compariſons; quoting the* Scripture *in one Place, and the* Poets *in another; or filling up Voids with Paſſages taken out of the* Apoſtolical Conſtitutions. *But I never had the Knack of*

ſpeaking

ſpeaking much, when I had but little to ſay. I might, indeed, with the Printer's good Management, have made four Pages of the Commiſſioners Names in Capitals, and then have humbly ſubmitted my Eſſay, *and ſubſcrib'd myſelf* their devoted and obedient Servant *in two Pages more; which, with the Copy of the* Act of Parliament, *and* Title-Page, *would have made up one Sheet: An* Introduction *of* Aſtronomical, Geographical, *and* Mechanical *Definitions, to ſhew that I was Somebody, might have fill'd the next Sheet; and the Devil is in't if I could not have made ſixteen Pages of my Movement; and ſo, by the Help of* FINIS *and* ERRATA, *compleated my three Sheets. But then I conſider'd, (ſince I am ſure of being right) that it was my beſt Way to go to Sea firſt, and give the Mariners ſuch Ocular Demonſtration of my Contrivance, that I ſhall have a ſufficient Number of Witneſſes of my Succeſs, to vouch the Account of which I ſhall, at my Return, lay before the Commiſſioners, and ſo carry off the* twenty Thouſand Pounds. *As for the Introduction, I ſhould have thought it very ill Manners, to begin my Book, as if I meant to teach Firſt Principles to thoſe Learned Philoſophers by whom I am to ſtand or fall. If it be aſk'd, why I wrote the Book at all, I'll frankly anſwer,* That I wanted Money; *and that if I had thought that the Commiſſioners would have been prevailed upon to have given me ſome, to carry on Experiments, I had never ſet Pen to Paper. For this very Reaſon, I ſhan't ſay a Word about my New Invention, till its proper Place. And if the Bookſeller does not cut open the Sheets, whoever has a Mind to know what I drive at, muſt buy the Book: Peeping in, won't do; for I ſhan't begin a Paragraph with the Deſcription of my* Curioſities, *or write the Names of any of my* Machines *in* Italick *Characters. All that*

I ſhall ſay here, is, That I have try'd all my Experiments at Land, with deſir'd Succeſs, and as ſoon as the Bookſeller has paid me, I'll go to Sea; and if, after all, I fail in the Attempt, yet——Vobiſcum certaſſe juvabit. *I am, Gentlemen,*

Your moſt devoted, moſt obedient,
and moſt humble Servant,

Jeremy Thacker, *Philomath.*

Well-wiſher to the *Twenty Thouſand Pounds.*

Advertiſement concerning the Longitude.

" IT is now well nigh towards half a Year, ſince " my good *Genius*, and *my Self*, found out " a Method for diſcovering LONGITUDE, which I " had publiſh'd before, had it not been on Account " of the Creatures of *Trap* and *Diſcovery*, who, (I " had Reaſon to fear) would have run away with " *the Secret that Nature had confeſs'd to* ME, *and* " *had refus'd to* THEM, *as often as they have aſk'd* " *her for it.* But now, that Things are ſo ſettled, " that no Body can rob me of the Benefit of my " Invention, I publiſh this to defy all that can be " done by thoſe of the *Sneering* and *Grinning* Kind, " in their proper Employment of *Ridicule* and *Gri-* " *mace:* And therefore I expect all my Readers to " be *Merry* or *Angry*, or *Grave* or *Serious*, upon " this Occaſion; but I muſt (and indeed I dare) " ſubmit myſelf to the *Multitude*, who, if I am " not miſtaken, will declare me a *Fool* or *Mad-* " *man*, with *Pomp* and *Ceremony*, for being ſo po- " ſitive; and therefore I do, by Aſtrological *Cal-* " *culation*, prognoſticate, that ſome will *deſire I*

" *ſhould*

" *ſhould be in the Wrong*; others will have *a Suſpi-*
" *cion that I am in the Right*; and the *Ignorant*
" will not know whether I am *Right or Wrong*.

Jeremy Thacker.

WHAT if the greateſt Part of the Pack have run upon a falſe Scent, may not the hindmoſt Dog hit it off? Perhaps, from my comparing the *Seekers* after the *Longitude*, to a Pack of Hounds, ſome arch Wags will ſay, that if one or two Dogs run mad, it is ten to one but all the reſt catch the Infection, and ſo look upon him as a Mad-man; let 'em *ſneer* on; for if I can but demonſtrate myſelf to be in the Right, and all the reſt in the Wrong, (as I am confident I can) their Laughing will be turn'd into Admiration; and when I receive the Reward, they'll ſay, *Who wou'd have thought it?*

If I ſhould follow the Example of the greateſt Part of the *Longitudinarians*, that wrote after the firſt Attempt, I ſhould take Mr. *Whiſton* and Mr. *Ditton* in Hand, ſhipwreck their *Hulls*, drown their *Sounds* in a Tempeſt, lift up the Waves to intereept the Sight of their *Fires*, and break their *General Peace*; but Gratitude forbids: They ſprung the Twenty Thouſand Pounds, and I hope to get it, I ought to be civil to them. Then let Mr. *D.* reſt aſſur'd, that I will neither meddle with his *Longitude*, nor his *New Law of Fluids*; and poor Mr. *W.* has been ſo often handled as a *Longitudinarian* and a *Latitudinarian*, ſo amaz'd at the Burſting of his *Mortar*, and one of his *Shells*, and ſo frighten'd with the Fall of another *unlighted one*, that it would be as barbarous as ungrateful for me to inſult over him.

him. No, I ſhall always own him the Maker of my Fortune. I had no great Acquaintance, no Friends at Court; I could by no Means have procur'd an Act of Parliament for my Encouragement: My Engine was ready theſe three or four Years; ſo I was glad when he ſtirr'd. I lay ſtill, well-knowing that he was beating the Buſh for me to catch the Hare.

Before Mr. *Hobbs* thinks of ſending his Spring-Movement to Sea, let him know how to make the Month of *June* in one Year, juſt as hot as the ſame Month in another, and ſo of every Day and Month in all Years; then his Inſtrument will be equally haſten'd and retarded at the ſame Seaſons; and then he may poliſh his Pivots, and make an Ætherial Oil that won't thicken and increaſe the Friction of his Watch.

Mr. *Bill—y* (after having acquainted us with ſeveral *admirable* and *ſurprizing Phænomena* of Nature, which he took for *Conjuring*, the firſt Time he ſaw them, but now dares venture to perform himſelf, (and by himſelf) very reaſonably tells us, That ſince the *Phoſphorus*, *Glaſs-Devils* in Water, *&c.* which would, to a Stranger, ſeem to be actuated by Magic; to us that are wiſer, appear to be the Effects of no other Arts, but *Chymiſtry* and *Legerdemain*; his finding out the Longitude, after ſo many have attempted it in vain, is a Thing no *ſtranger* than it is true. His *Movement* is ſtill behind the Curtain, but I'll think the beſt of it; and ſince he has vouuchſafed to tell us, *That he will, by Means of a long Pendulum, have a ſteady Motion in an irregular one*, I'll help them out, and aſſure him, that he will ſucceed, if he will do one Thing more, and that is, — prove Sir *Iſaac Newton*'s firſt Law of Motion to be falſe.

I have

I have little to ſay to Mr. *Br—e*, the Corrector of the Moon's Motion; but if his Application of it be practicable for trying to find the Longitude, I'll turn him over to the Aſtronomers, for the *Examination of his Theory*; and I would not be in his Caſe, if he ſhould fall into the Hands of Dr. *John Keil*, who knows how to revenge the leaſt Injury done to Dame Nature his Miſtreſs, by the falſe Reports of bad Philoſophers.

The Latitude, no doubt, may be exactly found by *Signior Al—ri*; but if he would diſcover the Longitude by his Machine, he ſhould deſire his Workmen to make him a long Leaver, not to *move*, but to *ſtop* the *Earth*; or if *Ptolemy* has done that for him already, let him ſhove up his Leaver, and ſtop the *Primum Mobile*: If he wants Help, Mr. *K--th* will lend him an Hand, and tell him what *Star* he ſhall chuſe for an *Eaſtern* or a *Weſtern Pole*. However, let not our *Italian* Gentleman be diſcourag'd from giving us the Figure of his Engine; for he is not the firſt Profeſſor of *Mathematics* that has fallen ſhort of the *Longitude*: And though I can't commend his Scheme, becauſe I am his Rival in this Caſe, yet, if he'll try for the Philoſopher's Stone, or *ſquare the Circle*, I'll *ſubſcribe* to it. And if *my Friend K- th* would have his Method effectual, let him take a Journey to the Moon, where he will be certain of his *Longitude*, by his Obſervations of the impending Earth; he may find a ſufficient Number of *Ganza*'s among the *Latitudinarians* to carry him thither, and the *Lunatick* Attraction between the *Moon* on the one Hand, and himſelf and the *Ganza*'s on the other, will make his Voyage ſpeedy.

Mr. *J. H.* Writer of the Eſſay, has ſuch a fertile Brain at Invention, that I know not how to deal with him:

——*He'll raiſe* Objections *dark and nice,*
And after ſolve 'em in a Trice.

And if I demoliſh one of his Movements, he'll pop upon me in a Moment with another. If I tell him, that the Mercury in his portable Barometer with the ſpiral Baſon, will vibrate ten or twenty Inches by the very Shake of the Ship, becauſe the common portable one, which is ten or twenty times leſs ſenſible as to the Mercury's Riſe and Fall, will, with the leaſt Shake, vibrate half an Inch) he'll ſubſtitute Dr. *Hook*'s Marine Barometer, and have me there again: But then (granting him his Theory of the Tides) he muſt conſider that the Moon raiſes a Tide in the Atmoſphere, as well as the Ocean; and as he riſes from his Level with his Barometer in hand, where he expects the Liquor to deſcend, he will find himſelf baulk'd, becauſe the Height of the counterpoſing Atmoſphere, will not decreaſe in that Caſe, as it would do at Land.

But then the *Pendulum* in the *Center of the Gravity of the Ship*, muſt it not always vibrate? That it will be in Motion all the while that the Ship goes, I readily grant; but then it muſt be in *abſolute Motion*; for if ever the Ship goes ſteady it will be at *relative Reſt*; (that is, (in mechanical *Engliſh*) at Reſt in Reſpect of the Things about it in the Ship) and therefore it will not move his Watch-Work. If he would have this Inſtrument go, let him conſult about it with the Inventors of a perpetual Motion; * and for his Time-keeper by a *Vacuum*, let him

* *He may hear of ſeveral at* Birmingham *or* Sheffield,

him aſk Advice of that Metaphyſical Gentleman who has wrote *a Book to diſprove the Exiſtence of Matter.*

I have ſeen no more Attempts for the Longitude, except Mr. *Wa*———*n*'s Advertiſement, wherein he promiſes a Clock to make the Longitude known to thoſe of the meaneſt Capacity; therefore ſince I think myſelf none of the Vulgar, the Expectation of his Wheel-Work ſhan't delay my Book; let the *Tars* examine the Machine, and judge of it.

There is another Gentleman that has a great Volume coming out, for which he hopes to have the Twenty Thouſand Pounds. His firſt Page of the *Quarto* ſent before, (to tell the World that he is coming) he dedicates to the KING, his next to the PRINCE, the third to the *Royal Society*, and the fourth to the Reader: So far I read of him; for the Language look'd like *Engliſh*, and the Printer had ſhew'd himſelf a well bred Man in the Diſtances of the Lines, and Bigneſs of the Letters, whoſe Size he proportion'd to the Quality of the Patrons. The Body of the Book was wrote in a Language that I could not underſtand, and ſo I muſt ſuſpend my Judgment, till I have ſent it to be perus'd by my learned Friend Mr. *Gr*———*n*, of *Cambridge*; for this Book may contain ſome of the Concluſions which follow from the Principles of his new Philoſophy.

In a Word, to put an End to all the Methods for diſcovering of the Longitude that have been publiſh'd hereafter, (always excepting my own) there are but two Ways by which it can be found, *viz. By the Improvement of Aſtronomy, or by the perfecting of Clock-Work.*

It is to be hop'd that Aſtronomy will ſoon be carry'd ſo far as to ſerve for this Purpoſe, unleſs the great Mr. *L*———, with an Induſtry equal to his Candour, ſhould join the *Fluxions* and *Series*, *which*

he

he invented, to his known Skill in the Laws of *Centripetal* and *Centrifugal* Forces, and ſo vouchſafe to perform the Work for the Benefit of Mankind.

But if Aſtronomy was much more improv'd, Teleſcopes of a competent Length, for Obſervations of ſuch a Nicety as is requir'd in this Caſe, would not be manageable at Sea, even tho' the Obſerver ſhould place himſelf in the Center of Gravity of the Ship, where there is the leaſt Motion of all; beſides in foul Weather, when the Longitude is moſt wanted, no Cœleſtial Body would be ſeen, to make Obſervations.

What remains, is a *Time-Keeper*.

A long Pendulum-Clock meaſures Time better than any other Machine whatever, at Land; but it can by no Means be brought to do it at Sea with the ſame Exactneſs, for the following Reaſons:

1. Becauſe the Pendulum does not vibrate in a Cycloid.
2. Becauſe the circular Arcs which it deſcribes, are, by the Motion of the Ship, made to be unequal, and therefore not *Iſochronal*, or perform'd in the ſame Time.

It is demonſtrated by Mathematicians, that if a Pendulum (*Fig.* 1.) ſwings in a *Cycloid*, as APB, all its Swings or Vibrations, whether great, as APB, or ſmall, as DPπ, are perform'd in the ſame Time; but the Pendulum P being faſten'd to the Center T of the *Semi-circle* F P G by the Thread or Wire TP, tends to ſwing in the Semi-circle FPG, in which unequal Arcs are not gone thro' in the ſame Time by the Pendulum. Some Clock-makers indeed have us'd *Cycloidal Cheeks*, as AT and TB, to guide the Thread or Rod of the Pendulum; but the great Friction between the Cheeks at T, and againſt

gainſt 'em along A T and T B, has made the Remedy worſe than the Diſeaſe; and therefore Pendulums have again been made to ſwing in Circles; but the Thread or Rod of the Pendulum, being made pretty long, and vibrating only ſhort Arcs of a large Circle, the Swings are Iſochronal, becauſe the ſmall Arcs of a Cycloid, and the ſmall Arcs of a large Circle, coincide. As for Example, if the Semicircle FPB be of about nine Inches Radius, and the Pendulum deſcribes nearly a Quadrate of it each Vibration, as it will do in going from *a* to *b*, then the Arc deſcrib'd, will run pretty much out of the Cycloid; but if the Radius of FPD, or what is the ſame, the Rod of the Pendulum, be four times as long as that which is made uſe of to ſwing Seconds, and the Pendulum itſelf pretty heavy, it will ſwing in the Arc DPπ, where the Circle and the Cycloid are ſenſibly the ſame Line; and therefore if no Force makes the Pendulum fly out farther than ordinary in its Vibrations, they will be all perform'd in the ſame Time, becauſe then the Cycloidal Arcs are deſcrib'd.

Now, at Sea the Motion of the Ship will cauſe the Pendulum to make large, and ſometimes ſmall Vibrations: But if it be anſwer'd, That a Check may be put to confine the Pendulum to vibrate in the Arc Dπ; I ſay, That as much as the Spring or Contrivance, which checks the Pendulum, is acted upon by the ſaid Pendulum when it endeavours to fly out beyond its Bounds, ſo much Motion is there added to the returning Pendulum, (becauſe the Action and Reaction are always equal and contrary) and therefore its Velocity is too much increas'd, *&c.*

This will always remain an unconquerable Objection againſt Pendulum-Clocks; for tho' the Ship

Ship ſhould not roll, (which never was known) yet ſuch a Clock would be uſeleſs: For, let us ſuppoſe the Ship to go very ſteady, upon the leaſt increaſe of the Ship's Velocity, the Pendulum will ſwing fore or aft with too great a Force, as for Example to *p*. If the Ship's Velocity be diminiſh'd, the Pendulum ſwings from Side to Side, the rolling (which we now conſider again) will by its Irregularity, produce the above-mention'd Effect; and this is all built upon this certain Principle, *viz.* That all moving Bodies, if acted upon by no extrinſecal Agent, always continue in their State of Motion: So the Pendulum, which, together with the Ship, was going forward with a determinate Degree of Velocity, continues to go on with the ſame Velocity, even when that of the Ship is diminiſhed, and ſo flies out too far, *&c.* And ſo likewiſe the contrary happens, if the Ship is accelerated, *&c.* the Pendulum either making too long, or too ſhort Vibrations.

I take no Notice of the lengthening of the Pendulum-Rod by Heat, and its contracting by Cold, becauſe that may be rectified by a Thermometer, and the Pendulum may be ſhortn'd, as you approach the Æquator by a Table of the different Lengths requir'd to ſwing Seconds in different Latitudes.

What I propoſe therefore, is, a Spring-Movement.

Methinks I hear Mr. *H———bs* anſwer, That I rob him of his Invention: But let us come to the Deſcription of mine, and then let my Readers judge; *but firſt take the ſeveral Steps that I made, before I came to a Certainty.*

It is ſome Years ſince I thought the Matter feaſable, conceiving that if I could by an exact Time-

keeper

keeper, find in any Part of the World, what a Clock it is at *Dover*, or any other Place aſſign'd, and at the ſame Time what a Clock it is where the Ship is, the Problem was ſolv'd; therefore I was reſolv'd to ſpare no Pains and Coſt to bring Clock-work to Perfection. When firſt the Pivots in Watches were made to go in Gems, I was reſolv'd to try what that would do; but after having us'd Diamonds, I found that the Pivots would run in highly hammer'd Braſs, almoſt as well; but upon ſecond Conſideration, I imagin'd that the Difficulty of poliſhing the Inſide of the Hole in the Diamond, was the Cauſe that I had fail'd of Succeſs: Then I try'd Rubies, which I eaſily drill'd and poliſh'd, and then they ſucceeded beyond Expectation; for my Pivots being very hard, and very little Oil put in at firſt, I found the Oil was gone in a little Time, being as it were ſuck'd into the Stone; but the Movement went then as regular as before. One of my Watches was about five Inches Diameter, and inſtead of a Spring, I apply'd a long Pendulum, and it went four Years without differing above 3, 4, or 6 Seconds from the ſydereal Time; but the great Difficulty was, how to make a Spring and Balance perform the ſame as a Weight and long Pendulum, which I thus found out, after having almoſt given over the Thoughts of it. I knew by Experiment, that the Pendulum-Rod was by almoſt $\frac{1}{20}$ of an Inch longer in the greateſt Heat of Summer, than in the coldeſt Winter Weather, and therefore kept a Table of Æquation to correct the Error. This made me imagine, that the Irregularity of the Spring, (which I ſometimes ſubſtituted, inſtead of the long Pendulum) was not ſo much owing to a Defect in the tempering of it, as to the Alterations made by different Degrees of Heat and Cold. Accordingly, taking a Spring made in the

the Manner repreſented in *Fig.* 2. and fixing it to the Board FGHE; ſo that one End was faſt to the Nail A, and the other looſe with a Weight hanging at it as B, I found that upon the Scale behind it FH, the Weight deſcended in hot, and aſcended in cold Weather; ſo that Heat not only lengthen'd, but weaken'd my Spring, and Cold contracted it, and added to its Elaſticity. It was in *December* that I try'd my Experiment, and hanging my Board with a Thermometer by it in a Green-houſe, I made it, from the Coldneſs of the Weather, gradually to ſuſtain Heat, which I increas'd 'till it became greater than the greateſt in Summer, ſo as to reach and exceed that in any Latitude, and thereby had a new Thermometer made of the Spring. I try'd ſeveral Springs this Way, and made a Spring-Movement with Springs thus try'd, and alſo apply'd 'em to my above-mention'd Clock, (which has gone four Years without any Oil, that which was us'd at firſt ſeeming dry'd up) inſtead of Weights, and a Balance inſtead of the Pendulum, in ſuch Manner, that all the Wheels ſtood vertical, that the Friction might be equal on the Pivots. I made this new Watch ſuſtain all the Degrees of Heat and Cold, as it had before done when ſingle, and made an Æquation-Table, by the Help of the Thermometer, as mention'd before, to correct the Time, always ſuffering the Machine to take its Courſe. I likewiſe try'd what Effect Moiſture and Dryneſs had upon this Movement, by making a Steam in the Room, with a large Veſſel like one of Mr. *Savery*'s Boylers, and ſucceſſively dropt cold and warm Water upon my Wheels, which I found to cauſe a conſiderable Irregularity on the Watch, tho' it did not ſeem to affect the Spring ſingly, unleſs according as the Vapour was hot or cold. I made no Table to ſettle the Matter of the

Moiſture

Moiſture and Dryneſs, becauſe I keep my Machine in a Vacuum, and can wind it up without letting in the Air, as will appear in its Deſcription. All that I am to do at Sea, is, to keep it as perpendicular as I can, that the Axes of the Wheels may be horizontal; but the Want of that now and then, can cauſe no great Error, eſpecially ſince I ſuſpend it like the Compaſs in concentrick Circles, and fix the whole to the Center of Gravity of the Ship.

The Way that I compar'd the going of my Watches with the true Time, was this: I made an Hole thro' a Wall about half an Inch Diameter, and upon the Gable End of an Houſe, at ſome Diſtance, fix'd a ſtrong Iron made in the Shape of DE, (*Fig.* 3.) ſo that looking thro' the whole in my Wall, and the Slit D in the Iron, I could ſee the *Bull's Eye* in the Slit; and when I could ſee the Bull's Eye again the next Night in the ſaid Slit, I call'd that a ſydereal Day, with which comparing my Machine as oft as the Darkneſs and Clearneſs of the Night wou'd permit me, I found it not to vary above 6 Seconds. I muſt, by the by, take Notice, that I cou'd not by this Contrivance find any ſenſible Parallax of the fix'd Stars, whether I look'd with the naked Eye, when the Star ſeem'd to fill the whole Slit in the Iron, or with a ſmall Teleſcope, when ceaſing to twinkle it appear'd like a lucid Point in the Middle of the ſaid Slit.

Here follows the Deſcription of my Time-keeper. (*See Fig.* 4.)

HIKL *is the Movement, with its vertical Dial-Plate, and its three Hands,* viz. *Hour-Hand, Minute-Hand, and Second-Hand, fix'd to the horizontal Braſs Plate* MN.

MXAECXM *is a Glaſs Receiver from which the Air is drawn out at the Paſſage* E, *which has a Valve to apply an Air-Pump or Syringe to, and then a Braſs Head*

Head to ſcrew over the Valve and more firmly hinder the Return of the external Air; but yet ſo as it may be taken off to apply the Syringe at any Time, if any Air ſhou'd have inſinuated itſelf into the Receiver; but to ſecure it, there is a wet Piece of Sheep's Leather on the Braſs Plate, which is always kept moiſt by Means of Water that lies conſtantly on the Plate between the Receiver and the Braſs Rim MN *made high for that Purpoſe.*

A *is a Braſs Collar full of oil'd Leathers, thro' which a Key paſſes, to wind up the Movement at* G, *in ſuch manner, that no Air ſhall paſs in whilſt the Clock is winding up; and that the winding up may not ſtop the Movement, thro' the Collar* C *ſlips another Key, to give Liberty to a Spring at* F, *which keeps the Watch going, whilſt the other Key winds it up.*

XX *is the Rim of the Braſs Cap of the Receiver, which riſes ſo high as to hold Water to keep moiſt the oil'd Leathers of the Screws of the Collars* A *and* C, *and of the Screw at* E.

At M *and* N *are two Ends of an Axis for the Movement, Receivers, and Plate to run freely in the ſtrong Braſs Hoop* POQ, *which likewiſe, by means of the Iron Point* QT, *and another (which is here ſuppos'd behind the Machine) moves in the other Braſs Hoop* RST) *which laſt Hoop has four ſtrong triangular Plates, three of which appear in the Figure) by means of which the whole Engine is to be ſcrew'd faſt at or near the Center of Gravity of the Ship.*

V V W W *is a Weight of Lead ſo fix'd to the Plate on which the Movement ſtands, as to keep the Watch always perpendicular, or at leaſt to bring it back to a vertical Poſition, when it is ſhak'd out of it; for our Watch is not accelerated or retarded by the mere ſhake out of a perpendicular Poſition, but by lying ſo long in another Poſition, as to have one End of the*

Axes

Axes of the Wheels ſuffer more Friction than the other.

By means of the Glaſs Receiver, the Watch is kept from being affected with the Moiſture and Dryneſs of the Air.

And the Thermometer, which is always to be near the Movement, ſhews, by Help of my Table, when the Work goes too faſt, or too ſlow, and how much too faſt, or how much too ſlow.

As for my Method of knowing what a-Clock it is at the Place where the Ship is, I ſhan't trouble my Reader with it, 'till I come back and mention it in the Memorial which I ſhall preſent to the Commiſſioners, and prove by Witneſſes; for that is a Poſtulatum to a *Longitudinarian*, and I don't know one of 'em who makes any Difficulty of it.

Now, gentle *Mechanico-Mathematical* Reader, I humbly ſubmit to thee, and leave thee to judge, whether or not my Method will do for finding the *Longitude* at *Sea*, and whether all thoſe that have been hitherto publiſh'd do not much fall ſhort of mine———

Lenta ſalix quantum pallenti cedit olivæ.

Jamq; Opus exegi———

FINIS.